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Ideas Exchange: Design and the post bio-tech-body

Haines, Agatha

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By

Agatha Catherine Haines

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A programme of advanced study was undertaken, which included taught modules taken.

Publications

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Haines, A. (2016) *'Museum Night.'* 05 November, Stedelijk with De Correspondant, Amsterdam, The Netherlands.

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Haines, A. (2017) *'(Corpo) Realities.'* as part of the 'PRIMER Conference'. 27 February, San Francisco, USA.

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Haines, A. (2017) *'Future Sapiens.'* ArtScience Museum, 20 May, Central Area, Downtown Core, Singapore.

Haines, A. (2017) *'Touchy Feely.'* Takram London, 20 May, London, UK.

Haines, A. (2018) *'2050.'* 23 May - 28 May, Cloud City, Hangzhou, China.

Haines, A. (2018) *'RE/ME.'* Swissnex, 11 July, San Francisco, USA.

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Haines, A. (2018) *'On the Fabric of the Human Body.'* Reading University, 07 November, Reading, UK.

Haines, A. (2018) *'Brave New World.'* 08 November - 09 November, Stadsgehoorzaal, Leiden, The Netherlands.

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Haines, A. (2019) *'Future By Design.'* 07 May, London, UK.

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'Technophilia and the Corrupt Body' (2015) [Exhibition] Menier Gallery, London, UK. 02 March 2015 - 07 March 2015.

'Body of Matter' (2015) [Exhibition] MU Gallery, Eindhoven, The Netherlands. 27 November 2015 - 07 February 2016.

'The Anatomy Lesson: Dissecting Medical Futures' (2016) [Exhibition] Waag Society, Amsterdam, The Netherlands. 24 September 2016 - 25 September 2016.

'Bazarre Bizarre' (2016) [Exhibition] Off The Lip, Plymouth University, Plymouth, UK. 24-21 October 2016.

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'Acoustic Osteology' (2017) [Exhibition] Etopia, Zaragoza, Spain. 12 May 2017 - 01 July 2017.

'Corpus' (2018) [Exhibition] New Media Gallery, New Westminster, Canada. 26 January 2018 - 08 April 2018.

'Taiwan Design Expo' (2018) [Exhibition] Taichung, Taiwan. 15 August 2018 - 16 September 2018.

'Spare Parts' (2019) [Exhibition] The Science Gallery London, London, UK. 06 February 2019 - 12 May 2019.

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'Designs for Different Futures' (2020) [Exhibition] Walker Art Center, Minneapolis, Minnesota, USA. 12 September 2020 - 3 January 2021.

RELATED AWARDS

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Haines, A. (2014) *'Being Human: Designing The Future Workshop.'* Chatham Historic Dockyard, with Helen Hamyn Center, funded by Arts Council England, 16 June 2014 – 18 June 2014.

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Haines, A. (2016) *'What Do We Do When We Draw?'* as part of "Off The Lip", Plymouth University, Plymouth, UK. 20 October 2016

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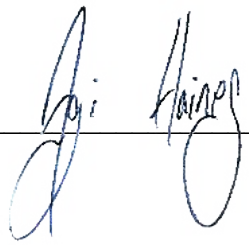
Signed: 

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ABSTRACT

Ideas Exchange: Design and the Post bio-tech-body

Agatha Haines

This thesis situates speculative design as a valuable tool for thinking about design issues and the body. Bringing together historical, theoretical criticism and practice to show that speculative design is intimately linked with the body.

The thesis' arguments build on the basis that both the body and design have gone through a processes of anatomisation: they have been dissected, separated and segmented into parts and terms. Those parts and terms are then ordered in a fashion which may not necessarily be advantageous intra-disciplinarily, that is for collaborations and discussions within a discipline. A different anatomisation is proposed for more contemporary models of design where the frequent use of relative points of reference is evident, in particular in respect to speculative design. This model in which speculative design is considered as adjunct allows designers to more freely share resources with other disciplines at their converging membranes and through doing so that design itself in these new iterations may be considered a useful investigative instrument for exchanging ideas.

Taking a 'research through design' approach, the text is informed by a portfolio of practice-based works that reveal the complex continuing relationship between design and the body. The eight original design works made for this thesis present body imaginaries influenced by technological change. The methods used to create the design outputs involved collaborative research and residencies which ultimately advocates the refinement of particular communicative tactics in speculative design. These tactics are outlined as a way to develop a sensibility for myself and those wishing to engage with the current zeitgeist of models of the body and design that may eventually be useful in fostering an ongoing exchange between them so that new forms may evolve in both body and design criticism.

ACKNOWLEDGEMENTS

Whilst doing yet another pre-exhibition all-nighter, moulding an alien pig sculpture in my childhood bedroom on Christmas Eve whilst staying with family, my Mum brought me a cup of coffee at approximately 4am. It was at this time I wondered how I could ever possibly write an acknowledgements page that covers the extent of the support from colleagues and loved ones. The Ideas Exchange that occurred during the making of this thesis has left traces with me that will remain indefinitely, and those are not just the traces of silicone that are impossible to remove from every single item currently in my wardrobe. I hope to continue to be sculpted by those who are named in this section and the extended network of collaborators, friends and family for many years to come.

Firstly acknowledgement goes to my primary supervisor Professor Michael Punt; a connoisseur of the engaging, the challenging and the unknown. Michael's incredible intellectual generosity and patience has shaped many brains, and has significantly moulded mine. Thank you for your encouragement and example. I will never forget our first encounter over coffee in the Watershed and now I will be another one of those artists and designers who continues to call Michael regularly.

Dr. Hannah Drayson whose references have been inspirational, thank you for your ever wonderful advice, your attitude has been exemplary in more ways than you know. Dr. Mona Nasser who opened so many alter-disciplinary doors and was such a bright light in CogNovo culture. Professor Sue Denham whose immense effort alongside Michael brought this unusual opportunity together and maintained a transdisciplinary haven which many CogNovians greatly miss. Thank you Dr. Martha Blassnigg your insights were the trigger for so many initial ideas, your kindness, intellectual presence and plant life will ever remain amongst the Transtechnology cohort. Thank you very much Dr. Steve Thompson for recommending I apply and for your insights in discussions and in your thesis which greatly shaped my thinking. Thank you also to Professor David Moles who welcomed me into many interesting dental discussions.

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and can be found in the portfolio underneath each project, all of you have been so influential in the making of these projects and I hope more ideas exchange will happen between us in the future. Thank you also to Dr. Brigitta Zics and Professor Chris Bennewith for your agreement to examine this thesis, I greatly appreciated your comments and critique.

I would like to thank all the fellows and extended family of CogNovo and Transtechnology. I would like to list everyone, but to my dearest friends Katie, Leigh, Raluca, David thank you for your amazing encouragement and the good, or rather, hilarious times. Special thanks to Diego and his vibrant attitude as well as Frank, Jack, Christos and Vaibhav who were fantastic and fun collaborators, I really enjoyed working with you all.

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1. INTRODUCTION

Elevator pitch

The body and design, an asymmetrical intimate relationship of relativities: the body and design have been influential in each other's modelling. The body being more fixed than design - with biotech the license has been given to designers and others to see the body as a malleable platform. Now that the relationship is more symmetrical, design acquires some intellectual autonomy, tactics and liberation to become an instrument of knowing the body.

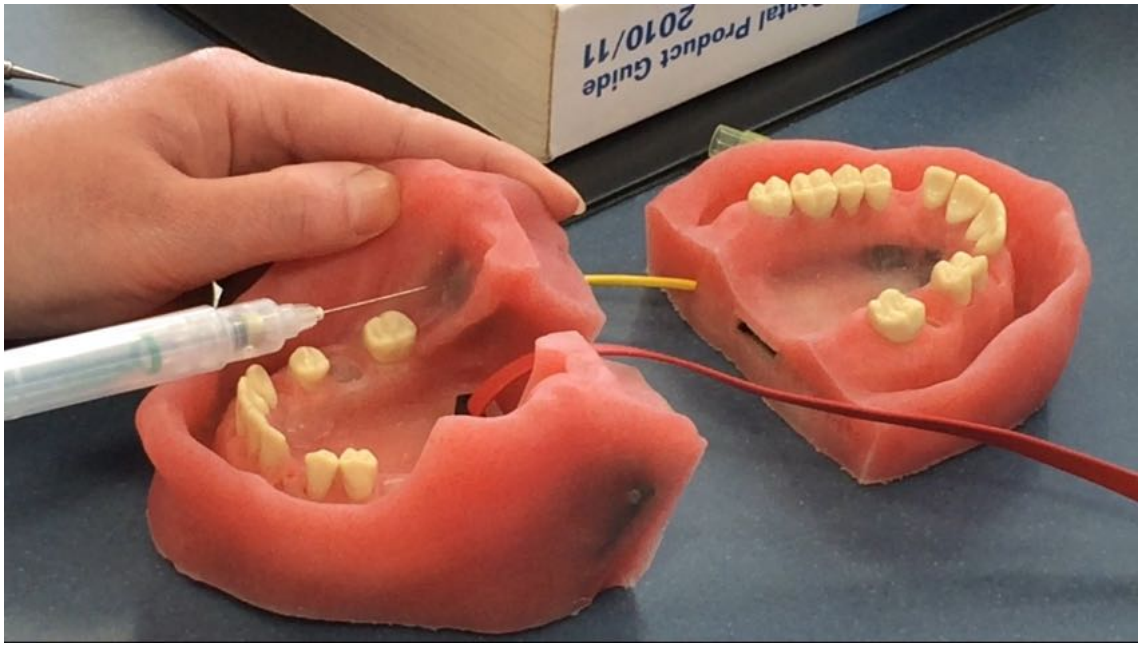

fig.1: **Photograph of interactive model of human jaw at Peninsula Dental School**

1.1. Things for thinking, a preamble

"Why isn't it slimy?" This question was raised upon being presented with a silicone and resin interactive[1] model of a human jaw (*fig.1*), during a visit with my supervisory team to the Plymouth Peninsula dental school's simulation laboratory. The lab contains high tech equipment and is notable for its dental teaching aids, yet an idea

[1] The model of the jaw contained metal inserts so when injected in the wrong place it would complete a circuit that triggered a red LED to light up and play a sound recording of someone saying "ouch".

which was perplexing was that the tools, chemicals and surrounding ephemera designed for teaching a subject well known for being situated in a wet and slimy environment were surprisingly dry. From a traditional design perspective, this may be described as a design problem (Goel and Pirolli, 1992). As analysis[2] would show, it seems to be a challenge for students to learn to transfer skills from the dry environment within the lab to a wet environment in the mouth. In the dental practice a large quantity of design solutions to this problem are visible, many of which introduce a number of other tools that can make the patient's mouth dryer (*fig.2*), and therefore more similar to the learning environment of the phantom mouth[3]. Slime in this case could be considered a design intervention to deal with the gap between the learning environment and working environment. Alternatively, a redesign of all the dry dental tools would allow the students to learn in an environment that resembles more closely that which they will later be working in. During this visit a vast range of solutions, ideas and speculations were being discussed. The dryness of the phantom heads, the Dremel ends, and the orthodontic tools were not necessarily the most significant focus of enquiry that arose from this interaction.

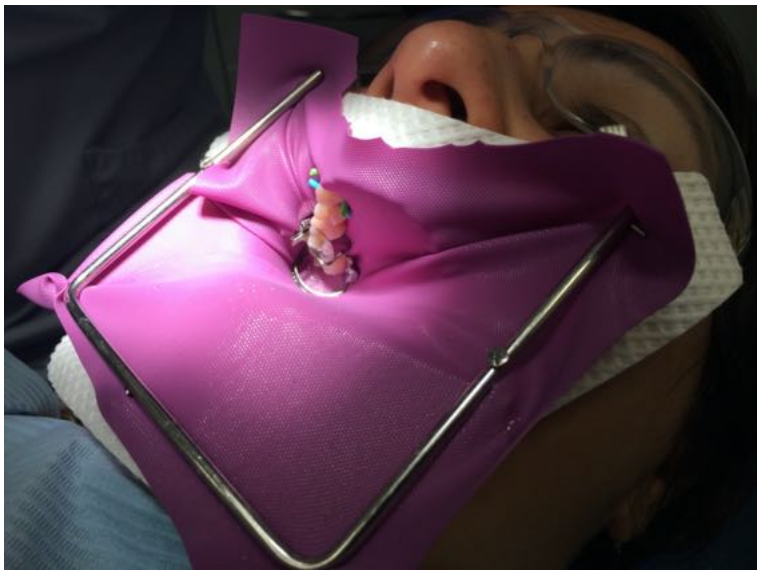

fig.2: **Photograph of rubber dam in use with patient at Peninsula Dental School visit to observe practice**

[2] Analysis being the "exploration and decomposition of the problem" (Goel and Pirolli, 1992, p.397). In this case analysis occurred through discussion with the lab technician and tutors who experienced this problem on a daily basis while training students.

[3] For example, the rubber dam (*fig.2*), which in R.H Moppitt's (1884) patent for a rubber dam holder is an "article used by dentists to protect the tooth from moisture while being filled" isolating a tooth creates a barrier between the tooth that is being worked on and the rest of the mouth, preventing saliva from interfering with a procedure.

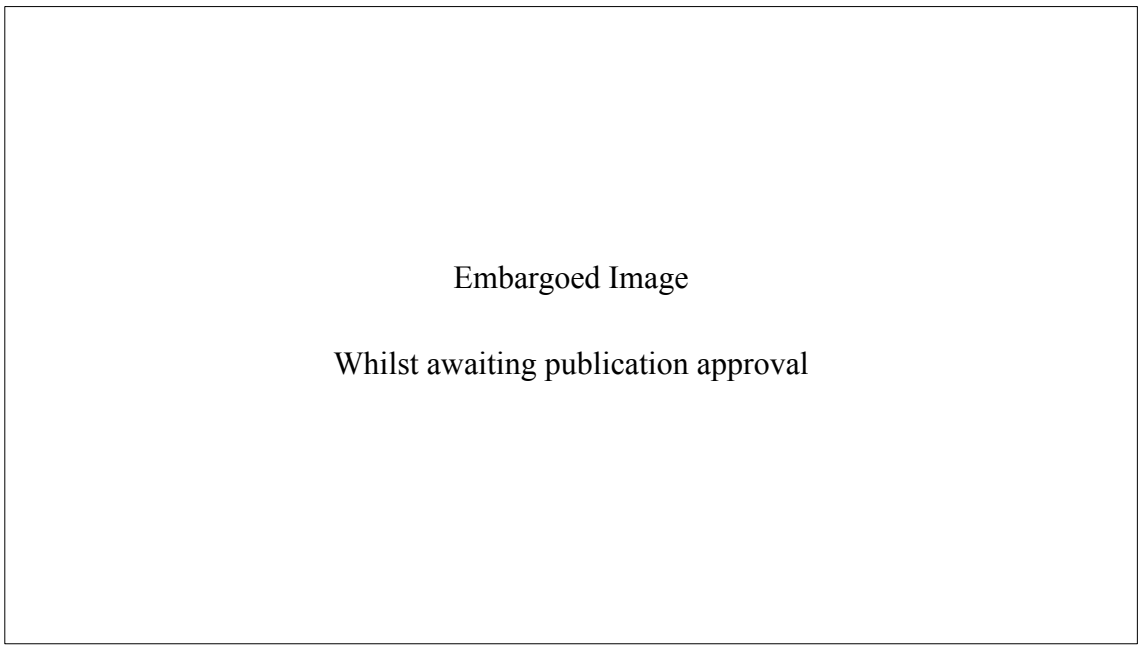

fig.3: **Screen shot from a Skype meeting with Marcel de Jeu and Jos van der Geest**

A year later I found myself on a fascinating Skype call with Marcel de Jeu and Jos van der Geest as part of the research for a Bio Art and Design Awards[4] collaboration for a project called *Drones with Desires* (appendix: Portfolio). While we were exchanging details on the focus of our respective research interests, Dr. Jeu lifted up a clean white bucket towards the webcam and much to my surprise pulled out a plastinated face specimen[5] (*fig.3*, face is blurred in respect). One month after this exchange I was sitting next to him at Erasmus neuroscience department in Rotterdam holding the face in my hands. It was beautiful, horrific, tragic, frightening, absurd but most of all it was disconcertingly slimy. While Dr. Jeu described to me the reasons for the oily surface, I found myself amongst another group of renowned researchers talking about whether or not something should be slimy. In the case of this artefact slime was also a design problem. Analysis during this engagement with the researchers again would show that Erasmus virtuously takes care of its human specimens in the laboratory in an incredibly respectful fashion. The face in my hands once belonged to someone who graciously donated their body in the name of furthering scientific research. It was an honour to even be allowed to hold it and it suddenly seemed disrespectful to consider

[4] A yearly award which facilitates and funds art and design collaborations. Artists and designers apply to work on projects with renowned Dutch science research institutions and groups. The work results in a combined research project and exhibitable outcome that was shown at MU gallery Eindhoven (Bio Art & Design Award, 2020).

[5] A process through which fluids are extracted from biological specimens and infused with resin.

this artefact grotesque. In this case it was not the absence of slime but rather the presence of slime that was the design problem. In this case the slime was a reminder that this face once belonged to a real person. This is certainly an important trait to be aware of, but also according to the plastination lab coordinator at Erasmus can be a psychologically challenging notion, which can be problematic when sharing ideas about the body, particularly in a pedagogical setting.

After being presented with these artefacts some considerations came to light. Firstly, the artefacts were both designed; they represent plans or structures of parts of the body that create mental models[6] to communicate the body and its functions. In other words, they reveal evidence of ways in which design intervenes in how the body is received. Secondly, that the artefacts being used to share mental models of the body for reference were not necessarily complementary to the purposes of describing the living human body, particularly in ways that directed engagement as it was intended. Thirdly, and perhaps most significantly, was the reason why I was being directed towards these two artefacts. The collaborators, who were not from a design discipline, had selected these specific artefacts to show me, a visiting designer. Why they had chosen them was perhaps not clear to either myself or even them at the time but has become more salient throughout the research for this thesis. I initially considered that these artefacts were compelling because they highlighted design problems or that they were unusual aesthetic items which may be of interest to a designer, someone who deals with aesthetics, but I believe these reasons were not solely the case. The artefacts were brought out as things for thinking, in both cases the artefacts became the conduit for sharing ideas, and specifying or shaping those ideas. They were selected by the researchers in a way that structured the direction of the conversation towards their concerns or interests. In other words, the ideas shared came from the unintentional design of an exchange. Without these artefacts the discussions would not have occurred in the fashion in which they did, and we may not have been able to otherwise verbally induce what we experienced in those moments.

These artefacts so profoundly influenced the exchange between those present that the ideas discussed oozed into my thought processes in a way that is now in hindsight abundantly clear in my portfolio of design work included in this thesis. These

[6] Description in 1.4. Locution section.

moments, focused predominantly around research artefacts, left an imprint on the way I think, ultimately resulting in a change in how I tackle doing 'designerly things'. This was not learning, being the acquisition of knowledge or skills, it was an ideas exchange: the sharing or communication of thoughts to bequeath an enduring cognitive trace. I use the word bequeath because the trace is left after the fact, and as these ideas were gifted to me often altruistically without considerable expectation of return. The traces are a series of thoughts which eventually might be a trigger for what Denham and Punt (2017, p.2) describe as cognitive innovation: the "explicit generation of something that measurably extends the knowledge and/or behaviours of others." The subsequent words in this thesis are an exploration of how the current practices of design might be involved in intentionally facilitating these exchanges particularly in relation to the body.

The sincerity of these scenarios taking place as research based at large institutions, with groups mainly made up of individuals, who in the past had not had the opportunity to have exchanges such as these, in itself highlighted that there is change in research focus, how we conduct research and how we reflect on research. According to Blassnigg and Punt (2013), this ideas exchange is evident of transdisciplinary research. Through the coming together of various disciplines,

> a key aim of transdisciplinarity is to facilitate emergent insight, knowledge and interaction that could not have been foreseen or designed in anticipation of a specific outcome or solution to a problem. (Blassnigg and Punt, 2013, p.3)

In hindsight the question, "why isn't it slimy?" exposed by a designer making a critical intervention in the context of a dental laboratory brought to light converging disciplinary paradigm shifts that have been developing since the sixteenth century to current times. Shifts that are not new abrupt ruptures but rather have a history of development and resurfacing. They are not the result of a singular specific trigger but rather they are fluid shifts in focus or attention due to the changing landscape of research. In recent times, two shifts in studies of the body and studies of design have made contact in a way that impacts how both the body and design are currently mentally modelled and therefore understood. The new collective mental models being the bio-tech-body and speculative design.

1.2. Design and the Body in Conversation

This thesis is based on the idea that a contemporary collective model of design, that being speculative design, is intimately linked with the body. This is because it is an aspect of design that is concerned with the psychological and physiological affects associated with the cognitive processes of imagination that reside in the body. To set up this connection this thesis creates links between design and the body in the way they have been dealt with as subjects of study, and in the way they are understood in mental models. It also distinguishes ways that speculative design may use tactics to facilitate the relationship between the body and design.

1.2.1. Thesis Outline

The paradigm shifts in question are occurring between models of the body and models of design created through the study of these topics. These shifts have happened asymmetrically as the study in methods of design is relatively young comparatively (Cross, 1993) to the study of the body. The shifts reveal a move from static models towards models that are provisional, intangible and speculative. These models of the body and of design have in recent times converged, putting the body and design in ever intimate dialogue with one another. This thesis describes the convergence between the new models of design and the body, and encourages designerly ways to engage with this convergence.

The thesis begins with an outline of a large event based design work created by the author titled *The Anatomy Lesson: Dissecting Medical Futures* (*The Anatomy Lesson*) (appendix: Portfolio). This section is an opportunity to explore one of the portfolio works, its influences, and contextualisation in fine detail as a case study. The case study is a description of the work specifically as it was presented at the Waag Society in 2016. This chapter describes the main insights gained from the production of the work which led to the subsequent parts of this thesis. Of all the portfolio works, this one is featured because it best embodies arguments in the text and is intermittently returned to as a reference. *The Anatomy Lesson* sets the scene for the thesis, describing this project as a case study example for a type of design work that is concerned with the creation

of models of the body and leads to a review of past visions to future imaginings of the human body within anatomical study.

Chapter 3 (Body) and Chapter 4 (Design) will talk about ideas exchange occurring through the generation of mental models. The models being allegorical representations of the body and design which are created to share thoughts in order to comprehend these complex topics. Chapter 3 (Body) describes the shifts in creation, establishment and advancing models of the body in anatomy through the lens of design, correlating body modelling to a design process. This situates the model of the body as a design outcome. This chapter also explores these three shifts through examples of an enduring body model across moments in history starting from the work of famous anatomist Vesalius (1543) and exploring the moments that led to a change towards an increasingly dynamic model of the body which has become of interest to designers; the bio-tech-body. This model arose particularly from use of the body as a site for biotechnological research. The bio-tech-body is a currently shifting paradigm that brings the body and design in convalescence with a different relation than before. The body and design used to share references that were fixed and unchanging which, although reductionist, a static body has been an advantageous reference for design in many ways. Particularly in the industrialisation of design products. The model of the body is no longer just a reference but a material for design.

Chapter 4 (Design) draws a link between the shifts in anatomisation of the body and in anatomisation of design. This chapter considers how and why design has been anatomised and somewhat mirrors the longer form shifts in anatomical study of the body. New movements in design, particularly “speculative design” (Dunne and Raby, 2013), show that the concerns of design are changing and it intends to be more involved in its own modelling. Like the body, the models of design currently being constructed are more dynamic. The converging paradigm shifts in the models of the body and models of design have led to designers more frequently creating work concerning the complex future of the bio-tech-body or post bio-tech-body model state. This chapter will propose that if the characteristics associated with forms of design such as

speculative design are considered anatomically adjunct to design, this will allow designers to have licence to tackle complex problems that may have previously not been considered design territory. The adjunct speculative design converses with other disciplines through being concerned with ‘trajectories’ and through ‘opening up.’

Now new models of the body and design are in the process of being cemented as paradigms, Chapter 5 (Body - Design) considers strategies for designers in communicating or engaging with the nascent body. This is in relation to four tactics which are considerably used in my own practice: comedy, irony, disgust and horror. These tactics show the hybrid nature of the adjunct speculative design described in Chapter 4 (Design), as its porous membranes allow reference from other disciplines to enter. This chapter aims to facilitate the use of these tactics through taking ownership of the terms in order to support a more designerly language and in turn *Designerly Ways of Knowing* (Cross, 1982). Or in the case of this thesis, more speculative designerly ways of knowing, with the overarching aim being in support of design’s intellectual autonomy as an instrument of knowing. This is in order to find nuances in the designer’s voice which may better communicate the challenges of bodily possibilities.

1.3. Methods

The foundations of this practice based research grew from insights gained as part of a collaborative PhD research group studying creativity and cognition called CogNovo (Cognovo, n.d.) as well as Transtechnology research (Transtechnology Research, n.d.). These groups were unusual in that they are research platforms for sharing ideas, approaches and working processes across disciplinary boundaries by promoting a transdisciplinary methodology. The understanding of ideas exchange in the face of rigid disciplinary boundaries has been greatly influenced by the collaborative efforts of these groups as well as external collaborators which are named in the portfolio. As a result, the production of the works in the portfolio and text come from a mixture of references aiming to reflect back on design processes in a way that I hope may have a lasting effect.

> [Transdisciplinarity] leads to a re-evaluation of disciplinary tools and concerns through interactive reflection and knowledge exchange, which can lead to transformative long-term impact on the development of disciplinary practice. (Blassnigg and Punt, 2013, p.3)

The purpose of this transdisciplinary approach is to re-evaluate the models of the body through the lens of design and to re-evaluate how the models of design might better engage with models of the body. As Blassnigg and Punt (2013) say above "to create transformative long-term impact" on how these disciplines function in dialogue with one another. In speculative design one result of reconsidering the designer's approach is a move away from solution driven design work towards a reflective form of design[7], in which designers become *Reflective Practitioners* (Schön, 1983). The type of work created holds a mirror to problems of the present but it does so through design judgements (Nelson and Stolterman, 2012, p.139-159). Judgements which often mostly occur in the grain of the making process. Positioning the new models of design anatomically in relation to other disciplines as well as intra-disciplinarily to design has proven a challenge to articulate amongst designers (Primer Conference, 2017)[8]. Regardless, designers have been successful at engaging audiences and collaborators external to design and sharing these new models across the different organs of design. The work seems to enrich models of design when transdisciplinarity is a core of the research process both external to and within the design discipline.

This thesis sits between a traditional practice-based PhD in the form of a body of physical work and a traditional theory-based PhD in the form of an extended critical textual work. The reason that this research sits between these forms may become clearer as the argument unfolds. This is predominantly due to the fact that transdisciplinary work does not always fit comfortably in the standard formats of one disciplinary or methodological camp. I review the making of one of the portfolio works in more detail in a case study but this hybrid format also allows a more thorough review of the critical context in which multiple works reside without the research being solely focused on one piece. This will allow me to make statements about this type of practice wholly rather than in relation to a single specific project.

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[7] This is instead to draw focus rather than to separate these forms.

[8] This problem was a topic of discussion at Primer conference (2017) in which people working with speculative design came together to share work and discuss the topics and concerns of speculative design. What was learnt from the discussion was that many designers had their own individual lexicon when it came to this form of design.

The making involved in the thesis has led to a number of extensive physical outputs which share a visual language and purpose. The portfolio attached in the annex shows work made using a "research through design" approach (Frayling, 1993, p.5). The entirety of the work in the portfolio was created during the research for the thesis and insights gained through the process of its making are responsible for the content of this text. All works included in the portfolio look at the propensity for design to reevaluate the nature of the material of the body in the face of nascent biomedical and healthcare technologies. Portfolio images will be referenced in the text as *fig.folio*. All works have been exhibited to the public in some format (elaborated on in the portfolio descriptions) and most have been supervised not only by my PhD supervisory team but also by external collaborators and institutions also to be outlined in the text and portfolio. The works in the portfolio build a model of design as it is described in the text, one that is dynamic through its provisional, intangible and speculative qualities. The text is not only a justification of the making but also positions this type of design work as an investigative tool to support the elements of the making that were particularly successful for ideas exchange. The review of the critical context of the work is in order to encourage these forms of design to continue to be shaped and developed upon. Any other works created by the author that are discussed but were not made as part of this research will be distributed throughout the text and listed in the above figures section.

Many of the practice-based design references outlined in this thesis do not solely originate from the design field. Many are from practitioners who are considered external to speculative design or that self-identify as external. Many of these practitioners still engage with speculative design in a variety of different ways. Methods found in speculative design are touched on in different design specialisms as well as in the arts and beyond. The works of those considered external are not referenced as a means to pull these practitioners unwillingly under the umbrella of speculative design. They are referenced firstly, because they show that the forms of design discussed in this thesis exist at the fringes of design practice and in many ways overlap with other disciplinary methods and outputs. Secondly, they offer important insights to this conversation and are those from which speculative design can learn and develop. Thirdly, the mixture of references supports a critical contribution of this thesis; that

speculative design and forms of design that share its traits and flavours are adjunct to design. Therefore the characteristics of speculative design may reach its tendrils across design and into other disciplinary territories.

Like the artefacts described from Penninsula Dental School and Erasmus neuroscience department the designed, artefacts both in the portfolio in the appendix and the referenced physical works of others will be described as things for thinking. In that they facilitate ideas exchange about models of the body as implicated by nascent biotechnological research and external stressors which may corrupt the body. This is provoked particularly through tactics of comedy, irony, disgust and horror described in detail in Chapter 5 (Body - Design). Significant moments of ideas exchange which have come directly from insights gained whilst partaking in practice based research are highlighted by a black thin line placed alongside the left of the text, to make these exchanges visible. Most of these insights occurred during the research for or making of the projects in the portfolio attached to this thesis. In many cases they outline subjective experiences supported by reference material that have sifted ideas to the forefront and in turn influenced the ideas in the thesis. This is to support that ideas exchange is not something that happens solely in the outcomes of the work but rather that ideas exchange can occur at other times. These lines show ideas exchange that led to particular personal realisations that shifted my own mental models of design.

Details of the making process, the audience and evaluation process are distributed throughout this thesis and are not separated into their own sections (and occasionally are revisited where it is important to restate them). The learning process and eclectic nature of ideas exchange is integrated to involve the reader more in the participatory aspects of the work. The layout is reflective of the coming together of ideas in the way that Nelson and Stolterman (2013, p.139-159) describe as “design judgements”.

1.3.1. Making Process

The general assumption is that making in design involves the crafting of materials (as outlined in Chapter 5). However, in addition this thesis includes a reconceptualisation of the materials available to designers: that is what the idea of materials can mean for a designer. As Nelson and Stolterman (2013) put it materials are

"what a designer brings together using structural connections or compositional relationships". They are "not limited to physical materials" (ibid.) but are also inclusive of abstract materials such as "material used in the composition of a process, or a symbol, or system, such as a number, essence and nature. It applies to people as social, cultural, and spiritual material" (ibid.). The process of making the work in the portfolio therefore is not explicitly outlined as interactions with the physical materials of production used to construct the objects. Rather it is revealed through the practice that the work of the thesis is to gain clarity over a number of research issues which demanded quite different modes of practice and research reporting. The process of making the work in the portfolio involved the 'bringing together' of physical and abstract materials, this did not only involve sculpting, painting, casting but also theoretical research, visits and residencies, and collaborative efforts.

It may seem surprising that there is little description in the text regarding the construction of physical materials, considering that the objects made during this research were so challenging, time consuming and considered in their making to achieve the results visible in the portfolio. As well as that the objects are often the initial means of exposure for many experiencing the ideas I am trying to exchange and the making is an important means of shaping those exchanges (as described through tactics in Chapter 5). That being said, some indication of the making process that involved the crafting of physical materials is described in the case study and elements regarding the aesthetics of the work are scattered throughout the text. The crafting of materials is also visible in the portfolio which includes some work in progress imagery for example, *fig.folio16* a slice of materials to test silicone shore hardness, *fig.folio21* a work bench image depicting the sculpting of half a face with Plastiline, *fig.folio39* a diffusion tensor brain scan being conducted, *fig.folio40* collaborators coding an artificial neural network, *fig.folio54, 55, 56* renders made to visualise physical models prior to sculpting. The reason for this omission was that a focus on the technicalities of the physical making distracted from the core driver of the thesis, that any speculative design process is linked to the conceptualisation of the body through materials. Making this case now sets a framework to better practise the practice. Meaning that elements of physical production can later be more finely interrogated on these grounds.

1.3.2. Audience

Issues of audience are also distributed throughout the thesis since an essential aspect of the research is the collaborative process with participants and publics. The main insight of the discussion on audiences being that designers are unable to wholly design the reception of ideas exchange as this happens in the mind of the audience. Audiences are described here not as passive attendees or observers to (for example) exhibition events but rather active “publics” (DiSalvo, 2009). “Publics are not a priori existing masses” (ibid.) they are built of individuals gravitating towards particular issues. This thesis touches on diversity in publics built through their “taste”, “attitudes", and “backgrounds”. It describes members of these publics and how they play a part in the making process described in 1.3.1. Making Process. For example, “proactive idiocy” (Michael, 2012) (Chapter 4) which overspills engagement events, offering interactions and insights which seem anarchistic but go beyond expectations of audience interactions and are therefore offering far more valuable reflections on the work. This thesis also describes collaborators as insightful members of publics who bequeath and receive ideas and the transdisciplinarity that results from collaborations which may help “reevaluate” (Blassnigg and Punt, 2013) disciplinary beliefs and processes. The thesis also describes instances in which collaborative publics “reaffirmed” (Briazu, 2017) beliefs and processes, which may have not been the intended response. This is outlined through individual collaborator’s responses to ideas and reflections on the collaborations (for example Velthoven’s insights on making the Anatomy Lesson, and Briazu’s paper referring to our collaboration) as well as group responses observed through talks (for example, laughter responses of audiences recoded during talks). The thesis also involves objects and materials of the body as collaborating members of publics, “working with materials” which “talk back” (Schön, 1983). For example, in the case of tactics “top-down” and “bottom-up” guttural sensations may cause a trigger of ideas. In the case of disgust, a bottom-up response may be an immediate feeling of disgust proprioceptively in the gut leading to a reconsideration in someone’s thoughts.

A fundamental aspect of the thesis in relation to audiences is the reception of ideas exchange as a means of creating mental models. Mental models are designed through the collaborative nature of ideas exchange and may be shaped by “opening up,” which is drawing attention to “often implicit assumptions” (Calvert and Schyfter, 2017).

The thesis also describes how publics are involved in mental model making, building ideas of their own influenced by taste, attitudes and backgrounds. As well as how design might guide the sfumato of tactics, the fusing of various means of making to shape how an ideas exchange occurs.

Further work on audiences which are mentioned but not fully explored in this thesis are concrete actionable means (beyond expanding where the work is presented, shown and gaining further collaborating members) for how audiences may expand to involve ‘underrepresented publics’ which would offer valuable insights. This thesis also posits that model making happens through the exchange of ideas leaving cognitive traces. Another element for further exploration is the nature of how these ideas are exchanged cognitively. This thesis focuses on how these exchanges may be designed and includes references for how design may learn from how other disciplines actively take part in this, but does not include how that takes place influenced by neuroscientific understanding of the brain for example.

1.3.3. Evaluation Process

This thesis takes a particular approach to evaluation. It may be impediment to the type of thinking associated with the models of design described to follow forms of data collections often traditionally expected of design, for example user experience research. This is not to suggest that data collection is not valid, just that data collection happens in different ways, or may need reevaluation to suit these design models. This is outlined in this thesis in the description of shifting forms of design from static to dynamic methods, specifically speculative design becoming increasingly provisional, intangible and speculative. The explanation of this paradigm shift sets the idea that speculative design is not audience driven or process driven but instead is a contingent response. The making reflects changing contexts, environments and beliefs, it is a response to radically changing ideas, in this case of the body. Those changes may even occur during events. This calls on Cross (1993) who suggests that many methods in design (particularly those involving routinised protocols) have been taken from science and that design needs to be more cognisant of borrowing language from other disciplines and instead should create a more “designerly language”. I also want to encourage a “speculative designerly language” in which speculative designers refine their language and shape how evaluation is conducted in a way that supports its

methods. This is so speculative designers do not start mirroring evaluation methods from social sciences for example, but to consider what forms of evaluation might best suit this model of design.

Comparisons between design and other disciplines is a form of evaluation. This is a means of reflecting of design practice through an alternate lens. A large claim of this thesis is that speculative design may facilitate ideas exchange, and can reform mental models. Although, as described in the text, the ideas exchange is challenging to capture in a number of ways. Firstly, that ideas exchange may happen at a number of points, for example during conception of an idea, in seeing a design object, in reflecting on it minutes, hours or even years later. The change in mental models may also have long trajectories, for example like the fork changing the form of the teeth, as described in Chapter 5, ideas may take time to permeate. Secondly, the capturing of mental change has been seen in psychology, neuroscience and behaviourism. Although after learning from my collaborators (Francis et al, 2017) that the collection of data can be a representation of change, this may mask levels of subjectivity and emotional response rather than wholly capture it. Therefore my process of evaluation freely acknowledges individual reactions from responses and audiences through dialogue. Described in the case study and through audience reactions in the "overspilling" (Michael, 2003) of public engagement events. Finally it has been made clear in the investigation into anatomisation in Chapter 3 that a measure can stand in the way of an object of study. As described in Chapter 3 the body becomes its measurement (the body datum). The datum stands for the body and to understand the body its measure is more often called upon rather than the body as it is in life. Chapter 4 draws comparisons between what has been discovered from the anatomisation of the body and can be applied to the anatomisation of design. In Chapter 3 Body, historical examples make clear that hard evaluations, such as those imposed by Vesalius, may have made deviances from anatomical norms problematic. Design may learn from this treatment of the body. This thesis therefore uses a softer evaluation approach to promote the malleability of this design model which ultimately aims to invite change. In conclusion, evaluation as discussed throughout the thesis has been maintained as a way to follow the nature and "design judgements" (Nelson and Stolterman, 2012, p.139-159) of speculative design. Drawing from external sources to understand the function of design in more detail.

1.3.4. Practice Based Methodology

As mentioned in 1.3. Methods, this thesis is an accumulation of differing outputs brought together through a practice of making. Consequently there is an intimate overlap between making and reflective practice (and first-person accounts). Predominantly a body of text and portfolio of design work. The making of these outputs was not just an iterative process but the process of writing and of making were in communication with one another, they are dialogic in that the writing and the practice influenced and changed one another as they developed. Morphing as ideas exchange occurred in my own mental models. This practice based method is representative of the ethos of ideas exchange, that ideas may surface through a mixture of differing inputs and that ideas may surface and trigger over time through engagement with other external influencers. External influences have also come from regular sharing of work and ideas to publics through exposure such as exhibition, events and talks.

Early on in the making process it became clear that the questions I was attempting to tackle needed a different kind of strategy. Collaborations and writing became part of the making. Collaborations are a means to offer reflective insights that may have otherwise not been visible from a singular perspective. As collaborator Dr. Raluca Briazu (2017) writes, our collaboration was a means of self reflection, it offered insights which reinforced or shifted ideas. The collaboration was therefore also part of a design process which shaped the mental models of our disciplines through our respective eyes. This collaboration was important to gain insight into how speculative design might be an emergent discourse that arises from reflection on how design theory and practice produce ideas exchange, this was only made clear through “reflection.”

The process of reading theory and making objects produces a different kind of thinking which Frayling (1993) describes as research through design (RtD). This is research where a goal is set and material research and development may build towards that goal of furthering, altering, improving or expanding on something. Bardzell (2015) talks about “research through design objects” (Bardzell et al., 2015) describing them as “knowledge producers”. As described in Chapter 4 working using a RtD methodology may be in line with speculative design, which is why the objects in the portfolio do not necessarily represent end points but rather threads that trail beyond (4.3.1. Trajectories of the body).

The practice-based methodology of this thesis sets up a discourse which is aimed toward speculative design outcomes. The practice-based research and writing together attempt to develop more refined models of design and the body where they intersect. In order to do so the making draws on bio-art and design, traditional figurative sculpture, realism and prop making aesthetics to bring these discourses together through the manipulation of materials. The making involved a number of material processes as a means to create this model, such as prosthetics, moulding and casting, lab work, sculpting, film making, graphic design, physical computing, 3D modelling, etc. These processes are more fully described in Chapter 2 Case Study as well as in portfolio imagery.

These outputs took time and refinement of skills, but are not the material processes that are predominantly in focus in the text. As the forms of design are shifting and new models of design are becoming more inclusive of adding new materials to their practice. These materials are becoming more provisional, intangible and speculative (explored in detail relation to body material in Chapter 3, 3.5. (i,ii,iii) and design in Chapter 4, 4.2.2. (i,ii,iii)). Materials described by Nelson and Stolterman (2013, p.175) now include abstract materials as described on p.125. This thesis describes speculative design as making with models rather than making with propositions. Therefore the ideas are also abstract materials being made and manipulated through the coming together of making and text. Publics offer cultural and social materials such as overspilling (Michael, 2012). As part of the practice-based methodology materials were accumulated. “Materials are what a designer brings together using structural connections or compositional relationships” Nelson and Stolterman (2013, p.175). Then materials were structured to represent and incite ideas exchange, “Materials are what a designer uses to midwife a design into its existence in the world, to make it appear and be experienced in a real sense” (ibid.). To refine the skills using these new materials also involves refinement or “connoisseurship” (Nelson and Stolterman, 2013, p.151) which is developed over time through practical training and lived experience (explained further on p.126). These new materials have predominant focus over those materials that are well established. Although the making was incredibly time consuming, and integral to ideas exchange as well as integral for my own career, a focus on the well established processes would not have helped me tell the story of where design is

shifting. Instead this thesis focuses on what nascent materials and processes support this shift.

The writing also became a way to evaluate and process what ‘thinkering’ and making was attempting to achieve in designing my own mental models and if it was impacting ideas exchange in others (Francis et al., 2017). Writing was also a means to constantly revisit work made earlier in the research process and how it might help me reflect on my own morphing ideas exchange that occurred throughout the making. This allowed me to be selective of particular experiences (highlighted by a line to the left of the text) that were particularly poignant in building connoisseurship in modelling.

1.3.5. Theoretical Methodology

This thesis draws on theoretical research from design criticism, particularly in relation to speculative design and other design models that are anatomically connected to these terms (described below in 1.4.2.1. Discursive design, 1.4.2.2. Speculative Design, 1.4.2.3. Critical Design, 1.4.2.4. Adversarial Design, 1.4.2.5. Design Fiction, 1.4.2.6. Ludic Design and 1.4.2.7. Contestable Design). Although these terms describe differing design models, the purpose for referencing these models of design together is firstly, that they are all adjuncts which anatomically reshape the configuration of design. Secondly, referencing these terms together is significant for making the argument that design is shifting and all of these terms are playing a part in that shift. They are also terms created by those that have signified related changes. I have also taken reference from design methods and design thinking, reading through and around design theorists such as Cross (1982, 1993, 2004), Buchanan (1985, 1992) and Nelson and Stolterman (2012) who talk about refinement of design centred language and methods. As well as philosophers such as Johnson (2008), Daston and Galison (2007), Haraway (1991), Dijck (2016) that look at the body as a site of negotiation. These readings have helped to build up an idea of the model of design described in this thesis and its concerns toward the body as well as how it is shifting from familiar orthodox design methods.

This thesis is a transdisciplinary study and therefore draws reference from disciplines external to design from which designers could benefit. References offered by collaborators make up a large part of the theoretical references external to design. The thesis is a nexus of discourses that are the dominant discourses brought to bare on

authority of bio-tech-body. This thesis brings together research from self-sustaining disciplines to show that new bodies and new design are making connections and exchanging ideas in a different way and with different configuration than before. All of these references are selected because they embrace the idea or movement toward the body as a malleable object. In reviewing references revealing the history of study of the body, particularly those related to anatomy have shown that the authority of truth about the body has shifted over time. After comparing these paradigm shifts in the study of the body and the study of design it is made clear that authority of truth about design has also changed and that in this new model designers are particularly drawn to visualisations and communications of the body. After following the stories of major shifts in anatomical study (Chapter 3 Body) and study of design (Chapter 4 Design) it seems that many views are contingent on one another (Chapter 5 Body - Design). An accumulation of many views spanning disciplinary borders are brought together as a means to describe an overarching movement which at first glance looks mirrored but in fact might be asymmetrical. Bringing these different discourses together reveal that design may ultimately progress when aware of how other discourses have managed shifts in modelling.

Transdisciplinarity has been explored through readings which have influenced the structure of the thesis and the open selection of references. These readings have been instrumental in defining and shaping transdisciplinary study as it is presented in this thesis (Calvert and Schyfter, 2017; Blassnigg and Punt, 2013; Punt and Denham, 2017; Wildevuur, 2017). These readings also refer to how arts and sciences can make meaningful shared contributions toward one another and have also shaped my collaborative efforts and therefore the physical outputs in the practice portfolio in the appendix of this thesis. The transdisciplinary aspect is not solely in the bringing together of diverse disciplines but instead transdisciplinarity is somewhat a discipline in and of itself. These readings have have influenced the selection of references that may inform one another. As with transdisciplinary research and collaboration everyone should take away what they did not have before - new topics and concerns for future research.

The rationale as to how selected references from discourses external to design feed into one another is as follows. Firstly, as mentioned above references are brought

together because they all deal with the body as a malleable site of change. Secondly, columns of bodies of knowledge reveal a helpful continuity between body discourse and design discourse as it is manifest in speculative design. The paradigm shift currently occurring in design is described in this thesis as a move away from static to dynamic methods. This move is mirrored asymmetrically in anatomy, therefore drawing from scientific references and history of anatomy may be insightful as design itself moves through shifts, just as the body has in Chapter 3 Body. For example, as described in Chapter 4 Design, Kuhn (1970) describes plateaus between shifts as “normal science” which focuses on foundations of practice and reinforces paradigms. Kuhn (1970) describes that moving between paradigms in scientific revolutions is often uncomfortable and disputed, particularly when concepts are fragile. The same may be said for design when orthodox design methods have been successful for periods of time new ideas may seem unstable and discomforting. When design shares ideas that are already matured they are generally acceptable comparatively to sharing novel ideas that may be less universally accepted. Or to draw from Raymond Loewy’s MAYA (1951) (Most Advanced Yet Acceptable) these ideas exist at the precipice or outskirts of acceptance. They are more vulnerable ideas that are novel and have a high cognitive load (Alexander, 1964) in that they are challenging mentally to manage. These ideas are…

> phenomena that are not very coherent, barely possible, almost unthinkable, and totally under-specified because they are still in the process of being conceptually and physically articulated. (Halse and Boffi, 2016, p.4)

The models of design described in this thesis may purposefully work in this area of ideas as a means to keep their anatomy somewhat amorphous. This is described in this thesis as a tactic which permits this model to continually be open to change. The anatomy of this model might allow designers to reach into other disciplines as its boundaries are not defined. Pulling insights from other disciplines towards design concerns and sharing design concerns beyond the static anatomical boundaries of design.

In avoiding grand theory and reductive approaches this thesis proposes a thicker understanding of the generation of ideas and how ideas are exchanged through design practice, and that these are processes that ultimately reside in the body. This is consistent with speculative design as a model of enquiry that raises questions or

encourages re-evaluation. It has been described as an “intellectual communicative device” (Tharp and Tharp, 2018, p.85), "a tool to create not only things but ideas” (Dunne and Raby, 2013, p.66), “designing debate" (Kerridge, 2015) it’s purpose described "to produce new images — new imaginative instantiations” (DiSalvo, 2012, p.111). This thesis recognises that to better understand these descriptions and the critiques of ideas generation and exchange in speculative design, first we must define where the ideas exist. This thesis claims ideas reside in the body, they are located in the body of the designer, the bodies of the collaborators and the bodies of the publics (DiSalvo, 2009, p.51). To better understand how ideas are generated and exchanged between bodies this thesis uses insights from other disciplines that have a seasoned understanding of the cognitive activity of ideas exchange (biology, cognitive neuroscience and behavioural psychology). This thesis does not discuss the biological processes of ideas, such as descriptions of firing synapses or reinforcement of areas of the brain through the rehearsal of ideas. Instead, assuming these insights from neuroscience to be genuine, it describes ways in which these insights may better refine how speculative design work communicates and what kinds of ideas it incites (particularly in Chapter 5 Body - Design). Many of these references are drawn from psychology. A few examples being the psychology of humour (Freud, 1960), empathetic mirroring and product emotion (Desmet, 2004), ecological validity (Andrade, 2018) top-down and bottom-up emotional responses (Cupchick, 2004) and emotional disgust (Tybur et al., 2009). These references help to comprehend how ideas occur and can be influenced from emotional responses to external stimuli. This may help to create a more distinct picture of how designs generate and exchange ideas in and between bodies, and therefore the insights may be actionably applied to design practice.

The discipline external to design that is most impactful on this thesis is anatomy. The reason why anatomy is so relevant to this thesis is that firstly, anatomy is a discipline that is concerned with structure and organisation of complex parts. Design is also a discipline structuring complex concerns and its own organisation (as made explicit in 4.1.1. The Anatomy of Design) much like anatomy has done in the past. Design may therefore learn from the misgivings associated with this structuring process. Secondly, design is now becoming more concerned with reconceptualising models, and many designers engaging with this practice are addressing models of the body. As learnt

in Chapter 3 (Body) anatomy's purpose is to generate body models, therefore if design is engaging with this enterprise its borders are greatly shared with anatomy.

1.4. Locutions

The following part of the introduction is a form of glossary. The list of terms below come from new models of design that are imbued with regional design reference. The below list of terms describe where they originated and their relation to the text; as opposed to a glossary which would be considered a list of conclusive definitions. The design terms below collectively form the basis of the research references for the term speculative design in the text; others have used these terms often interchangeably or overlapping one another. They are locutions as they come from specific design researchers and practitioners whose personal flavour of design is intrinsic in its anatomisation. This is described further in the preceding caveat. The preliminary three bodily terms are outlined a means of clarification.

1.4.1.1. Body

The term body is used often in this thesis to refer to the living human body as it is defined by Johnson (2008, p.669-680) as a body that is not reduced by separating it through modelling; it is the body in its fullest, as it is lived and experienced in life. Occasionally, the term human body is used as a means of making this clear. The purpose of this clarification is that when discussing the body, particularly in relation to biology, this is often suggestive of the biological body, which as Johnson describes is the body as it is viewed through biological research. The biological body is one that is often only considered as the mass of materials, flesh and viscera that make up the physical body, discounting the ecological, phenomenological, social and cultural facets of the body (Johnson, 2008). These separated elements are termed ‘models’ of the body. Models are used as examples to understand the main focus of study, forming or adding to a general understanding of the primary focus. Models are created though the use of representational methods and artefacts that describe elements, in this case of the human body, but are separated from the body as it exists in life. Models can dictate ways to engage with and know the human body, for example models of the kidney as it is understood in anatomy have informed how to do surgery on a living kidney. This thesis

also describes models of design, which equally use methods and artefacts to comprehend elements of the larger understanding of design.

1.4.1.2. Bio-tech-body

For some the hyphenation of bio-tech-body might be an odd decision as biotechnology and biotech are not normally hyphenated due to the perception that their integration is so entwined that they become a "well-established compound term" (Committee, C. Of B. E. S. M. Et al., 1994). Here the hyphen is symbolic of design making visually clear. "The hyphen serves as a connector rather than as an indicator of interruption or omission" (ibid.) In this case the hyphen is used as a graphic design decision to reveal the connection between these terms. The hyphenation makes the flow between these terms clear in their connected threads. The bio-tech-body refers to a model of the body which is both filtered through the study of biology and the study of technology, forming a model which is susceptible to change and therefore of interest to design. As design may play a part in modelling this body and therefore impact the understanding of it, and subsequently the form in which it changes. This is not a one way exchange, models of the body can also greatly influence biology and technology, remodelling them.

1.4.1.3. Models

This thesis frequently describes the act of modelling, this is in reference to mental modelling rather than the making of physical models. Mental modelling describes the thoughts that create a picture of how something is formed or functions in real life. Mental models (often just referred to as models in the text) inform how to interact with things and how those things should be considered. As models exist differently in each person's mind, this thesis will describe designs that strive for collective mental models. The designs for these models aim to universally impact how certain subjects are thought about. In the case of this thesis this will be the model of the body and the model of design. In other words, how design can play a part in how ideas of the body are perceived, and equally how design may play a part in how design is perceived through designing models of itself and therefore taking authority over its own modelling.

1.4.1.4. Adjunct

In this thesis the term adjunct is used to describe a new anatomisation of speculative design. In this case, adjunct describes a model that can span across multiple organs of design. It specifically draws attention to terms and ideas that enrich a basic context. An adjunct has properties that can be independent but also can be shared. Knowing the body can help to understand this, for example tissues of the body can stand alone in a petri dish as well as function within the body but in these two instances the tissues both do and express different things. Similarly design adjuncts may stand alone as a specialism and be part of the body of design, but in these two instances they both do and express different things. Therefore adjuncts are not just additive decorative elements to the body of design but they give it context or function, for example, enriching time, place, emotion. Adjuncts are "serving to connect and to express comment on clause content" (Merriam-webster.com, 2020). Therefore describing this form of design as adjunctive means it can add contextual qualities to other organs of design.

Anatomy is an adjunct to the body, it establishes a context for the body through breaking it into parts and changes the way it can be thought about. This creates the anatomical body; a model of the body that is adjunct to the body and is understood through anatomy. Similarly speculative design is adjunct to design and can change the way design is thought about. I use the word adjunct because it is stronger than an addendum or subordinate, but also because it has a special function. Due to the anatomical body being adjunct to the body it does not immediately change the body's underlying form. It is separated from the body through being adjunct and therefore when it stands alone as a differing model of body it can change how the underlying body is understood. When anatomical models of the body are seen as part of the body they can give it context or function. For example, an anatomical illustration of a spleen can reframe what a spleen is and how it works and therefore when applied to the body whole this may change decisions made in surgery. This thesis argues that the same can be said for speculative design, changing how design may be understood and therefore change how design is put into practice.

Anatomising speculative design as adjunct might offer benefits intra-disciplinarily, that is for conversations within a discipline. As a magnified lens may help

refine a model of design that may better apply to the body of design as a whole. Just as the adjunct model of the anatomical body is continually shaped by anatomists as a means to better apply to the body as a whole.

The use of the term adjunct here is not to imply that the adjunct parts of design or the body are dispensable but that they are a smaller modifying model of something larger. Anatomy is an essential adjunct to the body in modern medicine whereas in holistic medicine it is adjunct but perhaps not as essential. The claim in this thesis is that speculation is an essential adjunct to my design practice but in other cases it is an adjunct that is not essential but can add context.

1.4.2. Caveat; Anatomy of speculative design

This thesis will describe anatomisation as a form of compartmentalisation and categorisation of large and complex topics into parts to better comprehend them. This has historically been a commonly practiced method in research, seen in particular concentrate in the study of the body. The topic of design is also going through a process of anatomisation to understand and better describe its parts. Having separate terms may be fruitful in communicating transdisciplinarily to those external from design as a way to describe the intentions of design in different formats. Although rigid definitions may not be conducive for the development of speculative design intra-disciplinarily. Anatomisation encourages a tendency towards compartmentalisation, demarkation of territories, appropriation and colonisation. The consequences of this is that concern is around metadiscourse; discussions then focus on camps rather than contents. In a recent interview by speculative.edu, Matt Ward (senior lecturer of design at Goldsmiths University) responds to the question “what’s the difference between Design Fiction, Critical Design and Speculative Design?” In which he responds, “Not much, or more precisely, I don’t care” (Speculativeedu, 2020). Ward sees anatomisation as taking attention away from the larger purpose of the work, and sees it as a form of intellectual land-grabbing.

Conversely to leave anatomisation completely from the discussion may theoretically be throwing the baby out with the bathwater, as speculative design should be discussed on its own terms and without the generation and refinement of terms

design may lose autonomy[9]. Therefore, the resulting taxonomies may have to take different forms than when previous anatomisation has occurred. The terms below are descriptions rather than explanations, they paint a picture of the current state of the art of these terms. They are not terms with closed borders, particularly for those intra-design.

Currently the nomenclature regarding speculative design is a mass of viscera. There are key terms describing forms of design in close relation to speculative design which are used in this thesis as both descriptors and in references. These terms often draw the focus in discussions associated with speculative design in varying ways. Often with an intent to pull terms together as a whole towards a united or sole definition[10]. The terms are also occasionally used synonymously, for example some researchers group terms such as speculative and critical design together by referring to them jointly as "SCD" (Martins, 2014). As outlined in Chapter 4 (Design) of this thesis some researchers have began to anatomise it into its associated terms with differentiated parts (Malpass, 2012; Blythe, 2016).

This thesis displays a reluctancy to cut the body of design further for reasons regarding the nature of the argument; that speculative design is actually an adjunct model of design rather than an organ. This thesis will show that movements in designing the models of the body are similar to movements in designing the models of design, in which case the anatomical metaphors may describe the link between them. An organ in both cases is an established mass of tissues that have characteristics that work together in varying amounts for common goals or outcomes. For example graphic design might be considered a large organ of design. Speculative design, on the other hand, has tissues that are shared to a further extent across organs not only in the body of design but also perhaps even among other disciplines. It may therefore be premature to cut this model of design further, making new terms before its processes are understood, especially if it is adjunct. Therefore the addition of further terminology is not proposed, instead a new structure for the anatomisation of speculative design is offered to not lose comprehension of the topics found in the below terms. This is also in respect to an

[9] Ward also notes that one benefit is to communicate to external disciplines (Speculativeedu, 2020).

[10] For example the term "discursive design" (Tharp and Tharp, 2018) which is considered more of an umbrella term.

upcoming reference from Vesalius (1543), who decided to withhold an image of a body part that was too ambiguous, so as to not make its boundaries concrete through illustrating it in a way that may not be fruitful or supportive to its practitioners.

In light of the concerns of anatomisation in its current format the list of locutions below dwell more on the similarities between the current terms rather than the differences. As learnt from anatomical study of the body, differences are often the cause of delineation by a cut and currently there is not a logical place to make a helpful incision. In this case the terms in conjunction with one another reveal a model of design which has become increasingly provisional, intangible and speculative over time. In this thesis this form of design will predominantly be referred to as speculative design. This is in no way a means to position this term as a unified whole which includes the others. The reason for this being, firstly, that this was the territory of the primary research for this thesis. Secondly, that this term has a wide net that incorporates or shares characteristics amongst the following fairly contemporary anatomical models of design which are in focus here [11], [12]. Thirdly, that the term speculative design itself is indicative of the effects of ideas exchange that this thesis aims to bring to light, that is in relation to speculation. Below is a brief outline of the characteristics of these terms in relation to speculative design. Some of the characteristics are evidently shared between them but are characteristics that are more concentrated under particular terms. To more fluidly discuss these terms they all share tissues that:

i) go against the status quo

ii) prioritise imaginative and innovative forms of communication through strategies

iii) leave cognitive traces

Tharp and Tharp's (2018) extensive research into what they term "discursive design" successfully maps out this territory in an anatomisation of terms. They also caveat the anatomisation of these forms of design "we also address the naming of 'discursive design'—the irony of attempting to tidy things up by adding a new term is not lost on us" (Tharp and Tharp, 2018, p.24). Creating a glossary in this case also seemed ironic,

[11] "[s]ome relatives are: activism, cautionary tales, conceptual design, contestable futures, design fictions, interrogative design, radical design, satire, social fiction, speculative design." Auger (2013, p.11)

[12] Elliott P. Montgomery (2018) has created a map to show the relation of some of these design terms, although he also titles this mapping as "unresolved". Speculative design in this map encompasses aspects of critical design and design fiction.

hence describing these as a list of locutions. As these terms have come to represent those who played a part in instigating them and are therefore characteristic of factions in this form of design. The following list of locutions is therefore a means to navigate these definitions from the work of others and give some consistency to the model of design described in this thesis. To separate them in a list is in no way a means of stamping these terms and solidifying them into separate clusters. Instead it is to give coherence for the sake of the reader to understand why reference is drawn from research regarding these anatomised descriptors of design for the use of my model of an adjunct speculative design. The locutions also prevent detachment from their originators whose definitions and refinement of these terms were so influential towards the zeitgeist of design which is captured in this thesis. Preventing detachment may also help to show why they do not have overarching relevance to all who want to engage with this model of design. For many these terms continue to be contestable (Tonkinwise, 2015; Ansari, 2015). I believe this shows the vitality of the design discipline as attempts to describe it reveal it is still a shifting and changing monstrum. Therefore, loose anchoring of terms and acceptance of non-definitive descriptors may have some benefit to these terms remaining a source of ambiguity. If the terms are ossified the revolution is over; dynamic terms allow room for change.

1.4.2.1. Discursive Design

Tharp and Tharp (2018) consider discursive design an umbrella category that is inclusive of speculative design. Discursive design “includes more established and even quite esoteric versions that use design primarily as an intellectual communicative device” (Tharp and Tharp, 2018, p.85). Tharp and Tharp argue the design specialisms that fall within this category have similar intentions but use “varying tools, techniques, postures, and audiences” (ibid. p.24). Discursive design does not necessarily have to offer critique but instead creates messages through discourse, systems of thought or knowledge. Tharp and Tharp suggest all objects (similar to the things for thinking detailed in 1.1.) can operate discursively or encourage discoursing, but they are not necessarily discursive designs. “Discourse is not merely a consequence or possibility of an object’s existence—something that a discursive design shares with all artefacts. Instead, discourse is why it exists” (ibid. p.77). This influential description shares most qualities with the adjunct model of speculative design as it is described in this thesis, its

anatomisation reveals distinctions as well as similarities across these locutions. Discursive design is therefore a term to unify this form of design for the sake of designers to better situate and justify their work.

1.4.2.2. Speculative Design

Speculative design is a form of design that "thrives on imagination"; "a kind of design that is used as a tool to create not only things but ideas" (Dunne and Raby, 2013, p.66). Speculative design poses "what if?" questions in order to "open debate and discussion about the kind of future people want (and do not want)" (ibid.). For DiSalvo (2012), speculative design shifts meaning. "Speculative design works by isolating facets of culture and recasting those facets in ways that alter their meaning in order to produce new images — new imaginative instantiations — of what might be" (DiSalvo, 2012, p.111). Speculative design for Malpass (2012) is much more of an exploration of ethical and social implications, particularly in regard to nascent science and technologies. This means speculative design also usually involves transdisciplinary research. "Speculative design combines informed, hypothetical extrapolations of an emerging technology's development with a deep consideration of the cultural landscape into which it might be deployed, to speculate on future products, systems and services" (augerloizeau, 2013). For Auger and Loizeau it is the combination of artefacts and environments which allow speculation. The distinction with speculative design is that it often brings ideas of futures into the domestic sphere in order to question their absurdity or challenges through positioning them within otherwise neutral settings (Malpass, 2012; Auger, 2013). The ethos with speculative design is that through reimagining the future it might have an impact in its design. "Design speculations can act as a catalyst for collectively redefining our relationship to reality" (Dunne and Raby, 2013, p.2).

The term speculation is key in this description of design, particularly for this thesis as it makes clear that this form of design occurs both in the mind of the designer and the observer, audience, receiver or public. Speculation does not only describe what the designer does but also denotes the quality of engagement with the work. In other words, it is not only the designer who is creating imaginaries and revealing them through design, but it is also those encountering the work who are create imaginaries.

1.4.2.3. Critical Design

Design moves away from being a response to a "task or set of constraints" (Blythe, 2016) instead this term describes a form of design that suggests designers might be able to make meaningful and critical contributions. Critical design takes inspiration from the radical design movement and Italian anti design. "Critical design uses speculative design proposals to challenge narrow assumptions, preconceptions, and givens about the role products play in everyday life" (Dunne and Raby, n.d., p.34). Critical design involves the conceptual parts of design processes but uses this in and of itself to challenge societal acceptance of design products and systems to reconsider the relations between people and things. Not all speculative design work as it is understood now is critical, but critical design uses speculative design to make critical interventions.

1.4.2.4. Adversarial Design

Adversarial design describes "works that express or enable a particular political perspective known as agonism" (DiSalvo, 2012, p.2). DiSalvo expressed this form of design as though it were somewhat an adjunct, in that he believes adversarial design is something that can be practised across disciplines but generally happens through the making of artefacts or experiences. This type of design shares characteristics most closely with critical design but often involves more outputs that include public engagement and anarchistically driven critique. Both critical and adversarial design are not always dealing with future imaginaries but also with current pressing issues.

1.4.2.5. Design Fiction

According to Blythe (2016) design fiction extrapolates "drawing a line from historical trends out into the future through progressive exaggerations." The concept was first introduced by Sterling (2005) bringing to light the narrative qualities of design practices. Bleecker (2009, p.83) then explored this type of design further by looking at how design tells stories between scientific fact and fiction, and posits that design fiction can "tell thoughtful, speculative stories through objects."

1.4.2.6. Ludic Design

Gaver (2004) described ludic design as the pursuit to design for "open-ended, playful exploration." This type of design aims to consider ambiguity of design and the withholding of narrative. This form of design is also concerned with the role objects play in everyday life and how design objects might mediate interactions to function as things of discovery.

1.4.2.7. Contestable Design

This form of design also engages with futures but has more connections to art. This form of design creates contestable futures to "subvert technologies" (Zurr and Catts, 2006, p.79). This type of work disregards the "fantastical" aestheticised speculative design representations of technologies, particularly of a biological nature (Catts and Zurr, 2018), and retains characteristics that show the particular locution of its originators. Contestable design is to be implicated in the technology that is the subject of critique.

2. Case Study

2.1. *The Anatomy Lesson: Dissecting Medical Futures* (The Waag Society, 2016)

This case study is a description of one of the portfolio works in fuller detail. Below is an outline of the work itself, its background research and its influence on the subsequent parts of this thesis. The work in focus is an exploratory design project titled *The Anatomy Lesson: Dissecting Medical Futures* (*The Anatomy Lesson*) (annex: Portfolio). It will be described specifically as it was publicly exhibited at The Waag Society in Amsterdam[13]. This design work consisted of a number of outputs including an installation of multiple sculptures and artefacts, interactive experience, performance, public seminar, film and lectures. The work was the culmination of a fellowship undertaken in the Netherlands during the academic year 2015 to 2016. Below is an outline of the elements of the installation and performance, as well as a description of the insights gained from the development process and ongoing research.

The history of the site in which the work was shown has led to Chapter 3 (Body) which looks at paradigm shifts in models of the body. This work opens up a vision of the body in the early twenty first century as a less stable point of reference than it was prior to when the Waag was birthed as a notable site for biomedical innovation described in Chapter 3 (Body). By following the trajectory of scientific and medical attitudes to the body as it was rehearsed in the Waag over three centuries ago, and situating the design work firmly in this shifting context, it will prepare for the next move in this discussion. To consider what new strategies for knowing and engaging with the body might be useful in this shifting understanding of the body as a dynamic and relativistic entity, and the role of design practice in this enterprise.

[13] The Waag Society is now an event and research space that "operates at the intersection of science, technology and the arts" (waag, n.d.).

2.1.1. Residency

The Anatomy Lesson was the culmination of a year long fellowship awarded by Amsterdam Fund for the Arts as part of their 3Package Deal (3PD) (3Package Deal, n.d.) scheme. The 3PD supports local and international artists to live and produce work in the Netherlands. The scheme invites a number of creative practitioners to work on different platforms that are supervised by a coalition of external event spaces, research centres and institutions whose interests align. This collaborative effort was part of the Bio Design coalition, including The Waag Society[14], Mediamatic[15] and VU University Amsterdam[16]. *The Anatomy Lesson* was therefore highly influenced through the collaboration with this coalition as well as my supervisory team and fellow researchers at CogNovo and Transtechnology Research. During the residency I was based in Amsterdam and created networks and worked on projects related to the body and speculative bio design[17].

2.1.2. Edition shown at Waag Society

Due to the mixture of input from collaborators and the environment of the space, this edition of the event held at the Waag has different qualities to subsequent iterations. *The Anatomy Lesson* has been exhibited in different formats since its debut at the Waag. The work has since been exhibited as part of Museumnight at Arti et Amicitiae (Mystery of Truth, 2017), Gogbot festival (2019) and Albert van Abbehuis (Make the future, 2019). It has been presented in part as performances during lectures at Kikk Festival (Haines, 2016a), Shapeshifters (Haines, 2016b), and The Bellevue Theatre Amsterdam (Haines, 2016c) as well as a live recorded dissection in part at

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[14] Further details in Chapter 3 (Body) (waag, n.d.)

[15] Mediamatic, an event space who "research the possibilities and challenges that biology brings to art, design and society" (Mediamatic, n.d.)

[16] Particularly supervised by Toby Kiers from VU Ecology department whose work is about evolutionary selection pressures and how they lead to competitive expressions and mutualism.
"We use experimental evolution and phylogenic analysis to identify how mutualisms respond to radical changes in their environment"(The Science | Toby Kiers, n.d.).

[17] During my residency I took part in a number of other events, workshops and meetings at the Waag and Mediamatic but also at other related events in Amsterdam. This included 'Hack the Brain' a hackathon event, 'modify your genes' with Špela Petrič, talks and events at Dutch Design week. I also ran a series of workshops with Mediamatic that invited audiences to redesign their bodies through prototyping techniques, this included a basics in prosthetics modelling as well as moulding and casting techniques while discussing edits participants might make to their own bodies. This workshop series was integral for me to learn workshopping techniques that might engage members of the public. I also ran the event with a group of medical humanities students from Radbound university.

Frontiers conference (Haines, 2018). Most recent iterations of the exhibit includes ‘Spare Parts’ with Science Gallery London at their gallery site at King's College London (annex: Portfolio), which involved an exhibit and performance. The work as it was shown at the Waag is of particular interest because of the interplay between the artefacts and the Waag as a historic site. The work is not intended to be site specific as Nick Kaye defines the term being “practices which, in one way or another articulate exchanges between the work of art and the places in which its meanings are defined” (Kaye, n.d.). It is not necessarily defined by the location, as removal of the work from the location did not affect the overall meaning of the piece, although its meanings were enriched by the location in ways that told allegories of the body throughout time.

2.1.3. Description of overall work

In a quasi-simulation of future medicine, the audience, who take on the role of medical students, are invited to probe modified body parts in order to consider how to prepare for future procedures. The audience entered the anatomical theatre and were presented with surgical robes, gloves, hats and masks by myself and a colleague who were acting as lab technicians running a dissection class and dressed in medical scrubs (*fig.folio1*). The audience are then invited to take part in dissections of futuristic simulations, practicing the newly proposed procedures in a similar fashion to how it would be enacted in academic research on a cadaverous model or simulated moulage. The room where the work was shown is a historic anatomical theatre in which medical research and simulation has been performed since the 1600s (Waag n.d.).

The theatrum anatomicum is an octagonal space in which were distributed four discrete sculpture clusters (*fig.folio2*). Each comprised of a stainless steel table with a cluster of instruments and silicone, resin and mohair body parts placed on the surface as though there was a demonstration in progress. Each table also had a descriptive label (*fig.folio3, fig.folio4, fig.folio5, fig.folio6*) with an illustrated line diagram and a description. In addition the instructions invited the audience to interact with the work and facilitators were also in place to encourage interaction. Each table was 60cm by 90cm and was positioned in a semi-circle with space for the audience to stand around them and observe an imagined procedure in progress. The tables were spotlighted in a way to replicate chiaroscuro; reminiscent of the contrasting light effects painted in imagery borrowed from the anatomy lesson genre of paintings discussed in Chapter 3

(Body). A video of extracts from a discussion with collaborator and supervisor Dr. Mona Nasser played on a loop projected in the space (*fig.folio7*).

2.2. The Sculpture Clusters

Each table had a set of sculpture clusters of medical simulations. The simulations depict dissection specimens that exhibit pathologies of a post biotech future, in which the body is increasingly pervious to change and manipulation in the name of health. The clusters were made from various artefacts which collectively made the work. Each cluster was positioned on a table denoting a different procedure with a sculpture of a multiple part pathological specimen made from silicone, resin, pigments, oil paints and mohair. Alongside the sculptures were the armamentarium for completing the procedure or probing the work. Each sculpture was made to be destroyed through the act of dissection. This meant there were multiple iterations which could be destroyed and replaced and others that could be somewhat repurposed. The sculptures were made of platinum grade silicone[18]; which was painted into moulds with varying shore hardness[19] and pigmentation to allow for a variety of haptic sensations that would replicate those in the body and the imagined modifications. The image *fig.folio8* for example, shows a screen shot from film tests showing the warping and indentations made when touching the different parts, the cornea of the eye sculpture was particularly soft.

Medical simulation currently creates models by looking backwards. The history of moulage or wax modelling would mean artists and model makers could capture the aesthetic and tactile nature of a known medical issue or procedure from observation of a patient and use the impressions as reference to recognise similarly occurring issues (During, 2014). This project proposes that simulating ailments and alterations that may arise due to the onset of nascent technologies may help imagine or perhaps even pre-empt the surgical procedures of the future if the trajectory of current biotech research continues. Each sculpture imagines how the body may interact with a further future representation of a current or near future technology. The complex nature of these procedures in some cases offer hope for their continued use, and others reveal

[18] Otherwise known as addition cure silicone used regularly in prosthetics.

[19] A measure of the hardness or resistances of polymer and rubber materials.

ongoing issues, analogous to the complexities involved in the procedures of today. This work aims to encourage audiences to question if these biotechnologies are worthy of continued creative and scientific efforts on the basis of their complicated effects on the body; as well as to consider the logistical maintenance often ignored in descriptions of nascent technologies.

Each sculpture cluster was conceptualised in collaboration with researchers who during meetings, casual exchanges and discussions shared with me their excitement and concerns for research in their respective fields that are being currently funded or bleeding into their focus of study. Particularly those that expose the volatile interactions between technologies and the human body. Notes were taken from meeting sessions that resulted in two short films made to consolidate the conversations once the objects had been made. One in discussion with Dr. Mona Nasser and another with Dr. Vaibhav Tyagi. The topics of the sculpture clusters were also selected for their diversity of body parts. To show that the interfacing of technologies and the body is a concern that may impact the whole body.

Below is a description of the context, each depicted procedure, the elements which made up the sculpture cluster and aspects of the making that was integral to the audience's experience.

2.2.1. Bionic Eye Implant

The bionic eye implant (*fig.folio9*) sculptures depict how cysts may develop on the sensitive tissue surrounding a mechanical implant on the eye. Similar to those developed during periocular surgery[20]. In 1752, Benjamin Franklin wrote a report on his famous 'key and kite' experiment in which he speculates on the uses that may arise from his experiment with electricity. Franklin considers the effect of electricity on the eye (Watson, 1751), and his insights later influenced W.H. Dobelle's paper *Artificial Vision for the Blind by Connecting a Television Camera to the Visual Cortex* (2000) published in the American Society of Artificial Internal Organs. This research used an electrode array to stimulate the brain using information from a camera and was pivotal in framing loss of vision as a hardware problem between the eye and information sent to the brain. Supporting the idea that implants may be the key to reconnecting vision.

[20] Surgery of the eye or eyelid, in this paper some patients had had silicone or titanium plate implants similar to those proposed for bionic eye implantation (Kalantzis, 2014).

Currently optical bionic implants are being developed predominantly for visual impairments rather than alternative applications revisited often as popular science fiction tropes. Take, for example, the Tleilaxu eyes from Dune (1984), the telescopic eyes in The Six Million Dollar Man (1973) or the eye implants that have playback features in Black Mirror (2011). As procedures for enhancing vision popularise, there may become an influx of mass-produced and potentially problematic materials that are introduced into the market and in turn the body. Materials and objects with issues of toxicity or rupture are high risk to the body and can result in numerous complications[21]. When even a piece of dust or a stray eyelash can be extremely uncomfortable, introducing a foreign object in and around the sensitive areas of the eye could be even more problematic (Haines, 2018). "The human eye is incredibly sensitive, which is why foreign bodies like metal retinal implants can be so damaging, leading to inflammation and/or scarring" (University of Oxford, 2017). Vanessa Restrepo-Schild, who is developing soft biological synthetic implants, aims to avoid this issue. Although the developments in bionic implants continue to improve, many remain as experimental devices, such as the miniaturised computer in the Mojo lens (mojo, n.d.) which are yet to receive approval for clinical trials[22].

The sculpture cluster is a moulage of the operation involved in removing the implant and cyst, should one develop. The work consisted of ten life-size sculptures of eyeballs with bionic implants, with cysts appearing to grow over the surface (*fig.folio10*). Each eyeball sculpture was placed in a small square clear tray and was coated in clear unscented soap fluid. On the table were also tools, including: probes, forceps, scalpels, tweezers and containers for the implants. The audience had to cut and remove any infection or pus from the cyst and from the soft flesh that may have developed around the implant in order to successfully remove it with tweezers and place in a container for sterilisation. The audience had to be careful not to damage the sensitive optic nerve (*fig.folio11*).

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[21] In a similar way to the non-biocompatible breast implants made by Poly Implant Prosthese (PIP) which were recalled in the UK in 2010.

[22] Argus II, co-developed at the University of Southern California (USC) Eye Institute and manufactured by Second Sight Medical Products Inc., is now the only such device to have received marketing approval (CE Mark in Europe in 2011). Most other efforts remain investigational.

2.2.2. Nanoparticle Filter

The nanoparticle filter (*fig.folio12*) sculptures show an intervention which may prevent the inhalation of nanoparticles. Nanoparticles are easy to breathe in as particles are so small and light that they can become airborne. This becomes increasingly dangerous as chemicals, medicines and even potentially technologies such as nanobots with specific functions may be easily inhaled and have negative effects on the body. Research has been done on factory worker's lungs who are in contact with nanoparticles; showing how they can collect in the lungs and have adverse effects (Warheit, 2004; Song et al., 2009)[23]. As technology is becoming smaller and smaller the desire for nano-scale objects and particles are in ever high demand. Bots have been imagined and even tested that can make sperm permeate an egg more efficiently (Magdanz, Sanchez and Schmidt, 2013), or even fight off cancer (Li et al,. 2018). Those involved in the industries manufacturing these items might be particularly at risk of inhalation, as they are now with existing nanoparticles.

The sculpture depicted a trachea, lung, heart and liver. Inside the trachea is a filter which could capture hazardous particles; a potentially useful body modification for those in contact with this material, or perhaps even those with breathing difficulties. To encourage wariness regarding the increasing scaling down of technology and the impact this might have on the body. Nanoparticles have existed in manufacturing products such as paint pigments and sunscreen for a long time. The nanoparticle filter may function like a crude barrier similar to the filter in a vacuum cleaner, it may be a beneficial intervention for those most vulnerable to be protected from the high demand of technological manufacturing[24].

On the table with the silicone sculpture was a borescope and screen, the audience was free to use the borescope to explore the trachea and use long tweezers to extract the filter so it could be cleaned and replaced. As the main part of the sculpture was housed inside the trachea I also had to mould and pigment the inside of the work. The internal aspects were also covered in a fluid which made this a challenge to both

[23] Both papers of suggested reading were offered from my collaborator to gain greater insight on the topic.

[24] Speculatively this may not be afforded by the patient but could become part of company healthcare packages and plans in place by places like Apple for example through their AC Wellness affiliation company.

access the part of the trachea where the filter was but also to successfully grasp it with the tweezers. This simulation replicated the challenges with other similar operations in which slime-like bodily fluids can often interfere with tools.

2.2.3. Teratoma Tooth Transplant

The teratoma tooth transplant (*fig.folio14*) sculptures depict the possibility of growing a tooth within the body for implantation in the mouth. Using stem cell technologies the body could be used as a potential site for manufacturing or producing products through farming them using the normal growth of the body. A teratoma is a growth that is usually benign but can contain cells from other parts of the body, and even develop hair and teeth. The concept in this case is to encourage the development of a teratoma as a potential farm for teeth. Therefore, if the user lost a tooth they would have the option to have a replacement made from their own biological material ready to be implanted in their mouth.

Like all of the procedures in this project there are positives and negatives to these multiple operations. As described in the film interview with Dr. Nasser, on one hand it may be dangerous to induce the production of a growth and on the other this may satisfy the desire for natural teeth, as well as encourage the use of sustainable biological materials. This particular sculpture unintentionally encouraged audience members to divulge many personal stories of dental work, which encouraged discussions with the dissection groups on non-human materials entering the barrier of the body. In dentistry there have been solutions that have yielded functional and durable teeth for years. It is not unusual to have teeth made from metal (fig.4), plastics such as zirconia dioxide (Larsson, 2011) (fig.5) or even in the past made of substances such as wood, horses teeth or even other human teeth, as seen in the dentures of George Washington (Darnton, 2003)[25]. This possible route to growing natural teeth within your own body highlights the absurdity of technological progression which might be more harmful than having a plastic or metal tooth. As to have a natural tooth grown inside the body in this way would result in numerous operations.

[25] Letters between George Washington and his dentist were great inspiration for this part of the project, in which their interaction with one another seemed more like a collaborative effort found in Darnton (2003).

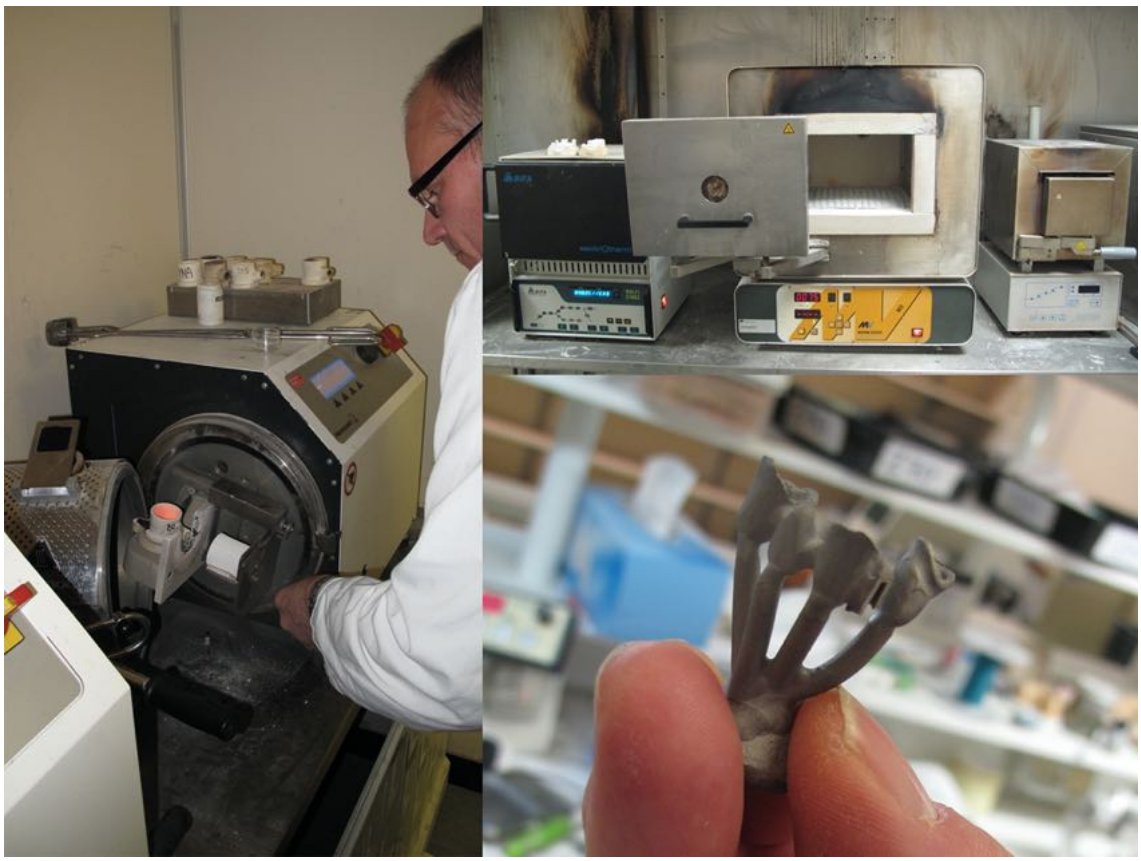

fig.4: **Images of metal tooth casting process from visit to Phoenix dental laboratory Exeter**

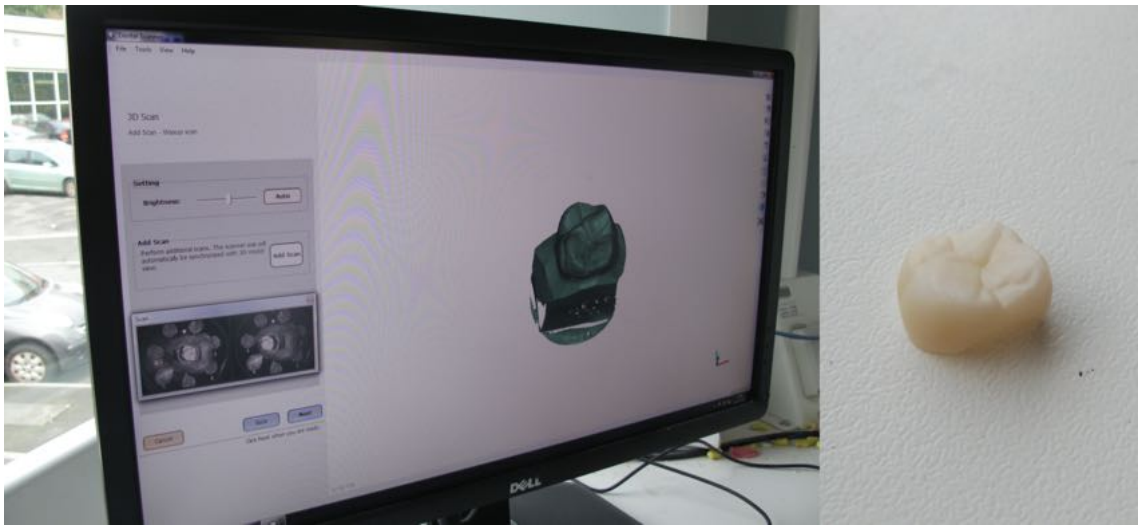

fig.5: **Images of zirconia oxide tooth printing process from visit to Phoenix dental laboratory Exeter**

The sculpture cluster consisted of a silicone leg segment specimen in cross section with a hard resin bone insert inside which could be cut and drilled into using a Dremel to reveal a pocket with a tooth growing inside. Once the pocket in the leg had

been cut open the audience could remove the tooth. They then had to fit the tooth into a gap in a half jaw specimen which was made using an inner mould so the teeth could be cast in resin and encased in an outer mould so the gums could be cast into a soft silicone (*fig.folio15*). This meant the bone had to be made in two segments so that once drilled into, it could be replaced with another one which would have to be covered over with a layer of silicone for cutting (*fig.folio14*). This work took the most time to recover after dissection and was made of multiple layers. A cut through slice of the leg showing colour variation of strata can be seen in *fig.folio16*.

2.2.4. Transparent Cranium

The transparent cranium (*fig.folio17*) sculptures showed the possibilities of tissue decolorisation or tissue clearing. This is a technology currently being researched which allows the removal of pigmentation in tissues, causing them to become transparent (Jing et al., 2018). This has been tested particularly in mice specimens in order to visualise brain pathways. According to Jing et al's article, bone is a successful material to make clear (ibid.).

Currently this is a process which only works on dead tissue, although it may be incredibly helpful if it could work on the living. This could mean that segments of tissue could be made clear in order to visualise the body more easily for surgical procedures. This would be of particular use during risky procedures in which sensitive areas need to be accessed, for example, specific locations of the brain. This sculpture visualises what it might be like if part of the skull could be made transparent in order to better locate a growth in the brain so as to reduce large cuts made in surgery which can be the cause of long recoveries. In this sculpture cluster audience members could remove layers of the head to reveal the clear skull beneath (*fig.folio18*), as though there was a window to the brain visible in image *fig.folio19* and *fig.folio20* where the skull segment with clear section is pictured. This process, although perhaps the most distant future of the four, is a medical imaginary which could prevent damage in surgery but leave the patient with a different kind of scar, a transparent one.

In *The Anatomy Lesson* event, the head consisted of six layers; the epidermis, which was silicone with hair inserted into it; a layer of fatty tissue and a muscular layer, both in silicone; a resin cranium layer with clear segment; a thin sheath that resembled

the meninges; and a segment of brain with a removable tumour. In later exhibitions this was exhibited to reveal the segments (*fig.folio19*) of which four layers were on display. Each layer was modelled (*fig.folio21*), moulded and cast into differing shore hardness of silicone painted into the mould with varying pigmentation to get the effect of depth in the details of the layers and to include veins and other embellishments.

2.2.4.1. Subsequent exhibitions Of *The Anatomy Lesson*

In later exhibitions the work has been shown in different formats (*fig.folio23*, *fig.folio24*), for example, at the Science Gallery London's exhibition *Spare Parts* (2019) the work was displayed to need less facilitation. The Science Gallery had trained their mediators to manage the simplified versions of the various interactions. To avoid high risk situations in public settings, subsequent editions beyond the Waag have had no sharps involved. Instead the work was developed to be probed with probing tools and tweezers. The work as it was exhibited at the Science Gallery also included descriptions of how to engage with each cluster using overhead projection onto the sculptures themselves. The projections would prompt times that the work could be touched, trialled and explored with care. The projections directed audiences to particular segments and included animations of specific parts of the sculpture that relate to the procedures (*fig.folio25, fig.folio26, fig.folio27, fig.folio28*).

Multiple eyeballs were made for a performance scheduled at the Science Gallery Site. In this event members of the crowd would be called upon to dissect a bionic eyeball implant sculpture while I directed them. This also included a preamble which described the heritage of anatomical theatrical events from which this work follows the performative tradition (*fig.folio29, fig.folio30*). The performances took place at a Science Gallery lates event in which multiple performances of dissections occurred throughout the evening.

2.3. "Two and a half reasons why this is interesting…"

Part of the event at the Waag included a live discussion mediated by director of The Waag Society, Marleen Strekker. On the panel of speakers was myself, my supervisor Professor Michael Punt, Professor Patricia Pisters and Mike Thompson of Thought Collider (*fig.folio31*). Each speaker brought various insights from their fields in regard to the nature and format of the event at the Waag in relation to their own work

and research practices. This discussion culminated in a comment by Punt which eventually became the inspiration for the structure of this thesis. Punt concluded our discussion by positing that "there are two and a half reasons why this is interesting…." Firstly, that the work makes an intervention in the body, the second is that it makes an intervention in design; those interventions or rather insights gained from the making of the work at the time were relatively ambiguous. Since being consolidated the interventions are outlined in Chapter 3 (Body) and Chapter 4 (Design) of the thesis. The "half" is not to say it is a lesser sentiment of the three, but instead that it exists between. The conclusion of the discussion was that this work and other work like it, for example, that of practicing designer on the panel Mike Thompson, is a location in which to discuss where the body and design meet.

Similarly to artefacts of medical history, the artefacts of *The Anatomy Lesson* are made as a means of exploring and understanding the body. Both types of artefacts represent the body but those of *The Anatomy Lesson* represent the body of the future. The artefacts share ideas about what kind of models might be advantageous for the future body, particularly in the face of body models that are becoming increasingly susceptible to technologies. *The Anatomy Lesson* aims to exchange ideas that are somewhere between design and anatomy in an attempt to find a model of the body that is acceptable, through provoking what might be advantageous to the body as well as what may be detrimental. In this way it also proposes another model of design, one that is involved in the communication of models of the body but also in ascertaining to what extent design should be involved in this enterprise.

The half way point described by Punt has come to represent a membrane which, as a result of the changing body and design, has become more permeable. This is also due to an increasing interest in both the nature of the study of the body as well as the study of design. This new permeability allows greater exploration, furthering the exchange between them. *The Anatomy Lesson* is evidence of the zeitgeist of thinking that currently exists around this half way exchange. Similarities can be seen here with Punt and Pepperell's (2000) *Postdigital Membrane*, although in reference specifically to the digital revolution, the metaphor of the membrane is applicable also to the biotech revolution. The membrane is not a separator between the topics of the body and design but connects them, facilitating the flow between them. The strategies discussed in

Chapter 5 (Body - Design) of this thesis may be considered as ways for design to promote the flow at the site of the membrane.

As well as setting up the argument for the thesis, the research for *The Anatomy Lesson* has helped determine the differences between the artefacts described in the opening of the introduction found in research institutions, and the types of speculative design artefacts created for this event. Through interaction with the artefacts of medicine, knowledge has developed regarding all aspects of biomedical and healthcare sciences. For example, how to remove tumours, how to attach a titanium hip or how to recognise lung damage, to name a few. This applicable expertise, although invaluable in support to medical education, are oddly founded as a result of a simulated and speculative reality; that being in the simulacrum of the living human form, originally learnt through the systems and processes involved in the physical act of dissection. Although these models still lack the motion, consistency, behaviour, moisture and smell of a living human, researchers seem to be able to gain significant knowledge for clinical use as they can still offer a simulation of how people could or should act towards the real thing. These artefacts are created to distil elements of the body using designed processes. The resulting models are not themselves physical artefacts but a comprehension of the body that is supported by the artefacts. Artefacts therefore help to build models.

The artefacts have differing purposes. The types of artefacts found at research institutions such as the silicone and resin teeth at Peninsula dental labs and the plastinated face at Erasmus MC are usually things for telling. They inform and share information about *what* the nature of the body *is*. They become things for thinking when they are used in a way that recognises that the membrane between the designed artefacts and the body is a constructed exchange. This informs and shares information about *how* the nature of the body *is*. The speculative design objects intentionally highlight the constructed membrane to continually question and reconfigure it as a way to be sure the membrane remains useful (Punt and Pepperell, 2000). Informing and sharing information about *what* and *how* the nature of the body *could be*.

2.3.1. Case study conclusion

This case study outlines the exhibited elements and inspiration for *The Anatomy Lesson* as it was exhibited at The Waag Society in 2016. This case study has outlined four sculpture clusters: a bionic eye implant, teratoma tooth transplant, nanoparticle filter and transparent cranium. The focus areas for these sculptures were informed by interests and concerns of researchers from varying fields of science during one-on-one conversations. Each sculpture cluster represents future pathological specimens revealing post bio-tech-body parts that have been somewhat modified to simulate the procedures of future healthcare. During a live discussion at this event it became clear that the types of subjects *The Anatomy Lesson* is concerned with are shared amongst many contemporary designers. That predominantly being how models of the body might change if the body is increasingly considered a material of design. The discussion also identified areas in which this work and that of others involved in similar topics may be able to make meaningful interventions, that being in models of the body and models of design. Finally, that the artefacts of *The Anatomy Lesson* are speculative design artefacts concerned with the exchange between the body and design at the site where they meet, and that artefacts such as these may be able to help articulate how the body and design should exchange through the sharing of possible models.

3. BODY

3.1. Shifting Forms of Body

This chapter of the thesis will take a closer look at the fundamental questions *The Anatomy Lesson* raised in relation to the body as a dynamic entity subject to cultural and technological change. This will follow a trajectory of how models of the body have been designed in relation to the systems and ephemera used to comprehend the body. Following a technoscientific move from the anatomical body towards the bio-tech-body through three shifts: creating, establishing and advancing models. The first shift being the creation of an enduring model of the body as a datum by Andreas Vesalius (1543). This section will consider the work of Vesalius as a design process, with the goal of creating a design outcome with clarity and focus. The second shift established the body datum model, particularly at the Waag, the location of *The Anatomy Lesson* chronicled in the case study. This was a shift in imagery of the datum to reveal skill and prowess of techniques through image making. The third shift will describe how the development of tools proliferated and cemented this model of the body as a datum. The lineage of tools follow a scheme to know the body that is informed by incremental changes to systems of past practice. In this case building iteratively on the techniques involved in cutting. Once the apogee of cutting is reached, the body model advances and new practices lead to new modes of discourse, particularly the use of biotechnology.

This narrative following the formula of the datum reveals an increasing detachment between the models of the body and the human body that they represent[26]. The nascent body model, which is technoscientific due to the increasing introduction of biotechnologies into its modelling, may narrow the gap through its provisional, intangible and speculative qualities. These qualities have allured a flurry of designers to

[26] Particularly informed by Thompson's thesis (2008) which argues for industrial designers to consider the human as a hybrid technological species rather than technology as separated and alienated from the body. Thompson also discusses the static references of design that have caused friction between the body and design. With an intent to find ways for industrial designers to talk about the changing view of the body.

engage with it, showing that it is progressively accessible to design in this format. Following the trajectory from the datum towards a dynamic model of the body shows the long and shifting relationship between design and the body. This is in order to demonstrate that contemporary designers (including myself) engaging with the body are not in fact trying to redesign the human body as it functions in life, but instead are trying to design and shape models of the body which in turn have impact on how the living human body is understood and dealt with.

The desire to make this argument is on the basis that I have often failed to articulate why my work does not necessarily propose transhumanist values[27], but is instead. a provocateur of them. As I found through the research for *The Anatomy Lesson*, models of the body historically tell stories about what the body is and how its materials should be engaged with, and designers like myself are continuing this tradition with differing techniques and focus. The work is not an attempt at creating models in order to make the claims of science, or implement technological change, instead it is an exploration of the claims of technology. I hope that this chapter may make the differentiation more coherent between designers creating propositions for new bodies and those making provocations on new models of the body, of which I would consider my work to fall in the latter category.

3.1.1. A subject for design

Design is primarily at a human scale, in that it is usually by humans and human bodies for humans and human bodies. Design is predominately anthropocentric. According to Dreyfuss (2003, p.41) designs are "ridden in, sat upon, looked at, talked into, activated, operated, or in some way used by people individually or en masse." The human body has long been a fundamental reference for design to acquire the knowledge that allows designs to engage with bodies. One example of many being the hand as the earliest calculating machine and therefore perhaps even the basis for the structure of mathematics and time (Ifrah, 2000). Current day design artefacts and systems use references from the human body developed in study such as ergonomics and human

[27] Transhumanism "holds that current human nature is improvable through the use of applied science and other rational methods, which may make it possible to increase human health-span, extend our intellectual and physical capacities, and give us increased control over our own mental states and moods" (Bostrom, 2011, p.55).

factors[28], to "leverage fundamental knowledge of human capabilities and limitations" and therefore "yield design principles" (Sage Journals, n.d.)[29]. Anthropometrics is a study of the body that makes references for design inextricably clear[30]. Anthropometrics deal with dimensions of the physical characteristics of human beings, and are the standardised blueprints for body referencing for products such as vehicles, office furniture etc.

Why is the body a suitable subject for design in these formats? According to Victor Papanek "design is the conscious and intuitive effort to impose meaningful order" (Papanek, 1984, p.4)[31]. For Papanek, design involves making sense of the complex and the messy. For a designer to make sense of the complex and messy body they must acquire knowledge of it. "To produce a design presupposes instrumental knowledge of the nature of both material and form" (Nelson and Stolterman, 2012, p.175). Ergonomics, human factors and anthropometrics are models for designers made to structure the materials and forms of the body. The body when understood in these forms provide guides and fixed standardised measures and functions, situating the body as a datum from which designers can make things according to its rules. Design takes from these references usually in a one directional exchange. In this case the body is a subject for design, it is an objectified baseline from which reference is drawn[32]. Stephen Thompson (2008) writes that for industrial design these references have long been considered "resolved". A static soma has been a fruitful resource when designing

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[28] Ergonomics and Human Factors consider bodies in relation to their working environment, (Fernandez, 1995) taking into account psychological and physiological factors that might inform how to effectively design systems and products for human use. This is not only in relation to product design, in graphic design typography has to be visible to the human eyeball and in architecture the body must move throughout a space, and all must be comprehensible to the human brain.

[29] This is the about section description for the Journal of the Human Factors and Ergonomics Society.

[30] Anthropometrics is the general study of measuring bodies to understand levels of variation. Here I mainly refer to anthropometrics in relation to anthropometric charts which are descriptors of averages but also show levels of suitable variation.

[31] Often the word design is used as a noun to describe an outcome, an artefact or a final piece of work. In this thesis design will predominantly be considered a verb, an occurring and ongoing process.

[32] For Daston and Galison (2007) scientific images and atlases that will be outlined below in the case of *Fabrica* prescribe how things should be known. The atlas is a guide for practitioners to know "what is worth looking at, how it looks, and, perhaps most important of all, how it should be looked at" (Daston and Galison, 2007, p.23). Design draws from the these atlases to know the body objectively, so takes more traditionally from averages rather than individuals.

products and services that will come into contact with the human body[33]. A utilitarian approach to the body as a datum means products and systems can fit into the lives of many. The body as a datum therefore supported the industrialisation of design, as "the concern of the industrial designer is with the mass public" (Dreyfuss, 2003, p.48)[34] products could therefore be made with highest likelihood of accommodating a multiplicity of users. The body as a datum gives designers freedom to not have to consider outliers. Meaning designers have freedom to shift their focus elsewhere.

> While everything else may appear to be fluid, designers imagine that they can at least rely upon this model of the human as a fixed material entity. (Thompson, 2008, p.37)

Design may traverse the references from this datum freely without concern of the complex and messy when the references themselves are fixed.

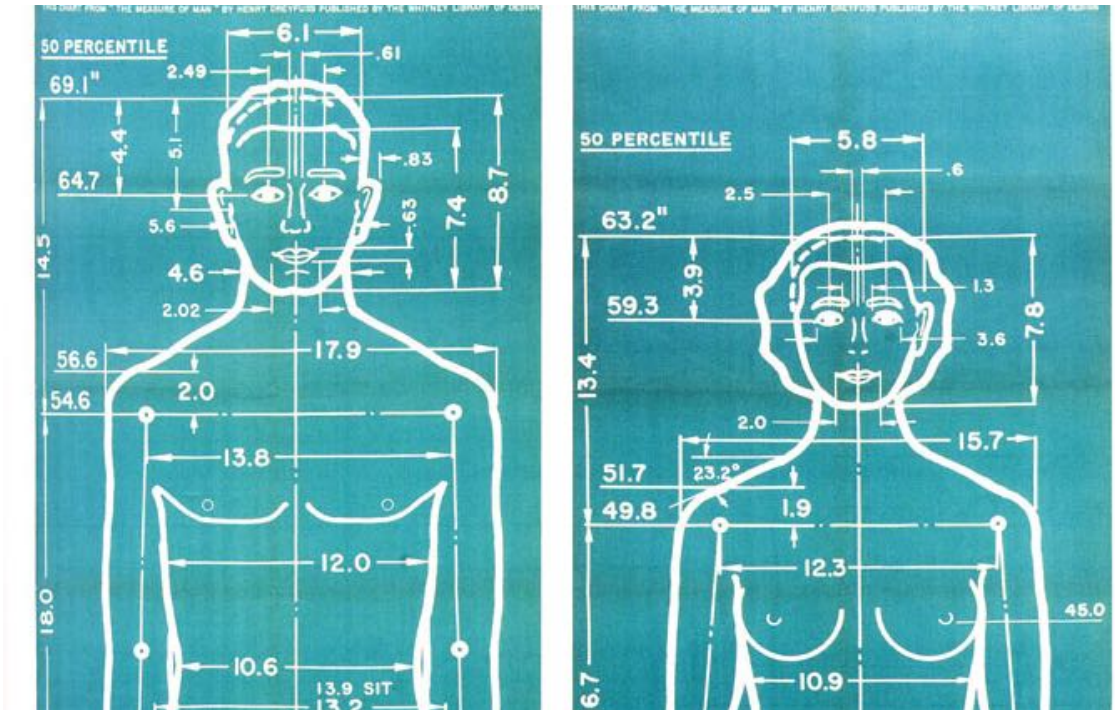

fig.6: **Posters, The Measure of Man (Male and Female), Joe and Josephine, Henry Dreyfuss (1969) (first published 1959). Cooper Hewitt https://collection.cooperhewitt.org/objects/51497617/**

[33] Consider for example the cup made to fit the average hand or a tea bag containing enough tea to suit the human taste buds. Although not for all, as the datum inherently ignores anomalous nodes and variations. Consider the use of an average cup for double upper limb amputees.

[34] Although it is clear Dreyfuss had a limited vision of the body, as his references for models were based on the averaging of small groups.

3.1.2. A subject of design

The body is also subjugated by design, in that design is also responsible for "resolving" the body (Thompson, 2008) by shaping and communicating it. To continue the example, anthropometrics do not only shape things in association with the body, they are themselves designs of new models of the body. The creation of the body as a datum through these models means that it is the informant to which all designs for bodies and all bodies should adhere. Anthropometrics are therefore used to create optimal products in relation to the body as well as the design of optimal bodies. For example, use of the Joe and Josephine figures[35] have been standardised references to create designs for 'normal' bodies[36] and the cephalometric dental measurements[37] recognise pathological traits to make the body 'normal.' Measurements such as these could mean the difference between a comfortable or uncomfortable seat, and the face being pathologically deviant enough to require surgery or not[38]. Individual bodies are therefore not the baseline or datum but designed and constructed models of the body are.

The models define how the body should be understood and dealt with. The body is filtered through these models to be understood; in the case of anthropometrics the body is filtered through measurements. The way the human body is dealt with as a result of these models is described by Mol (2002) as "enactment." Mol (2002) argues that the body is "an intricately coordinated crowd" (ibid. p.viii), it is enacted in many ways through the different means it is approached and in different circumstances. The body, although often considered one entity, is actually multiple through the different

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[35] Thompson (2008, p.267) writes "Joe and Josephine represent a model of how a potential uncertain entity, such as the human body, can be made to fit into a defined system…Joe and Josephine fix a normative model of humanity in the minds of designers."

[36] Dreyfuss (2003, p.48) believed Joe and Josephine were more than anatomical averages, they showed extremity of range. "Merely assembling average measurements from anatomical drawings would not have been difficult. However… we must consider the variations from small to large in men and women. After all, people come in assorted rather than average sizes." "Joe and Josephine have numerous allergies, inhibitions, and obsessions. They react strongly to touch that is uncomfortable or unnatural; they are disturbed by glaring or insufficient light and by offensive coloring; they are sensitive to noise, and they shrink from a disagreeable odor" (Dreyfuss, 2003, p.49). Although these models may show a larger range they are still incredibly reductive, particularly in their defined use which in the case of the book is limited to specific groups limiting roles of sexes and lack of diversity.

[37] These measures are used as a tool for surgical planning (Tenti, 1981). The cephalometric dental measurements can be referred to in order to check suitable distances of teeth, angles of their placement and relation to the jaw and other aspects of the face.

[38] Proportion indices are also an indication of facial attractiveness, and used often in aesthetic surgery to achieve a more normative attractive face (Edler et al., 2006).

means in which it is engaged with. The many models used to communicate it are authorities driving this engagement. This is because the model is created to be an epistemological baseline to convey knowledge about human bodies. As learnt through the research for *The Anatomy Lesson,* models can inform and share information about what the nature of the body is. Hence the use of metaphors associated with making or production, the datum of the body is "constructed" (Mol, 2002). It is a systematisation, organisation and communication of parts. In referring back to Papanek's description one might say it is *designed*. The following text in this chapter will consider the models of the body as designs.

Thompson (2008) describes the friction that occurs when design uses models of the body that are "resolved," as designed things do not end abruptly. When a design enters the world it has an ongoing effect as its relevance and use changes over time. Designs for and of the body also have the propensity to shape the human body over time. For example, approximately two hundred and fifty years ago the rise of cutlery in Europe had a lasting effect on the shape of the modern jaw. The fork has particularly influenced the topography of the bite and distribution of teeth, as condensed into this poem by anthropologist C. Loring Brace (1986, p.696)[39],

> Dentists still put up a fight, Against the thought that it might,
> Just be everyday use, That served to produce,
> The norm of the edge-to-edge bite.
> But the source of our dentists' confusion, Is just a Platonic illusion;
> Knives and forks are the cause,
> Of the shape of our jaws,
> In their post-industrial occlusion.

The prevalence of the modern overbite is a feature revealing that entities such as culture and the body "contribute, in complex ways, to each other's constitution" (Michael, 2002, p.2). The teeth change to accommodate the fork, just as the fork accommodates the teeth[40]. The construct of the body datum initially used to influence the design of the fork has now reshaped the body[41], meaning that the construct of the body datum should be redesigned, which means the fork should be redesigned to accommodate the new

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[39] Brace is a biological anthropologist who writes particularly about Darwinism, in this case in relation to how objects and food have impacted the shape of the face, jaw and teeth.

[40] Many other examples of this exchange exists, such as how cars have altered speed perception and central heating has altered temperature norms. Hodder (2012) outlines examples such as tools being responsible for the changing shape of the hands and how language has affected brain development.

[41] It would be a-miss here to not mention the multiple masses of influence on trajectories of bodily characteristic change, for example evolution (seen in Brace's argument, 1986), but these changes are also imposed by environment much of which is designed.

datum, ad infinitum. This results in a long form leap frog effect where design consistently has to change to accommodate the shifting forms of the body and things that surround it[42]. This is one way to keep the design discipline relevant, in that the datum of the body is one of planned obsolescence that ever needs updating. In this long back and forth between the body and design, a need for a model of the body emerges; one that is dynamic and inclusive of change as opposed to a static datum.

The designs for body models and their relationship to the human body as it exists in life changes as a multiplicity of technologies are created to enact them. Looking back over this relationship it becomes easier to see the occurring shifts that have allowed designs for models of the body and the body in life to remain in a relevant dialogue or exchange. Below is a review of the momentous shifts in designing the models of the body which have led from it being considered a datum towards it being considered a dynamic entity that is more provisional, intangible and speculative than before.

3.2. The Body as a Datum

In the mid sixteenth century a notable paradigm shift occurred which left a permanent mark on the construct of the human body. Situating the study of anatomy as the primary authority on the comprehension of the human body and its parts in ways that are still prevalent today. This was solidified in a pivotal publication *De Humani Corporis Fabrica Libri Septum*[43] by Andreas Vesalius (*Fabrica*) in 1543. Vesalius' work and research caused "with startling suddenness the beginning of modern observational science and research" (Vesalius, Saunders and O'Malley, 1982, p.9). As *Fabrica* developed a rhetoric around the communication of the body still deeply embossed in the discipline of contemporary anatomy, "some of his arguments could well grace a modern research grant proposal" (Magner, 2002, p.75). Vesalius was a pioneer who shifted the study of anatomy "back from stagnant scholasticism to vibrant observational science" (Lanska, 2015). Prior to Vesalius, Aelius Galenus (Galen) was the basis of

[42] For example average height has changed throughout the years therefore averages such as standard bed sizes and clothing also have to change.

[43] Which translates to *On the fabric of the Human Body in seven books* (Magner, 2002).

knowledge on the body visible in European medieval pedagogy (Carlino, 1999)[44]. It is clear in Vesalius' work his attempt to escape the previous models of the body. *Fabrica* articulated disillusionment with Galen's insights and techniques and offered a proposal for a new methodology in anatomical study. The updates suggested were met with distain from philosophers and physicians who had followed Galenic dogmas "virtually without question" (Magner, 2002, p.74). Regardless of the tempestuous reception, the Vesalian reform of anatomy offered contributions to the study of the body that corroborated significant and enduring characteristics of modern anatomy, principally the design of the body as a datum.

Fabrica proposed a design for a model of the body, a body which was "meaningfully ordered" (as Papanek wrote of design above, 1984). Retrospectively, the Vesalian reformation of anatomy revealed decisions for communicating the new model which mirror principles of an orthodox design process.

> The process of design; the process of inventing physical things which display new physical order, organisation, form, in response to function. (Alexander, 1964, p.1)

For both Papanek (1984) and Alexander (1964) design involves responding to things in the world in a way that makes them in some way comprehensible through structuring them. According to Cross (1993) there has been a history of attempts to capture or model design methods that may describe how design is done, although many systematise it in a way that is not universally applicable. The most relevant map of design methods to this argument is *The Process of Design Squiggle* (*fig.7*) by Damien Newman (n.d.). The final result of the squiggle reveals the intent of most design outcomes, to have "clarity and focus" (ibid.). This three step process described in the annotation of the *Design Squiggle* is mirrored clearly in the intentions of *Fabrica*. (3.2.1.) A new physical order began to be shaped in research and synthesis, (3.2.2.) a new organisation was imparted through concept and prototyping and (3.2.3.) the new form of the body model shared the designer's dream for clarity and focus of a design outcome. Below is an outline of these three Vesalian interventions in anatomy which mirror the design process depicted in Newman's map. The Vesalian design process formulated the characteristics of modern anatomy and created an anatomical model of the body, through which the datum was predicated.

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[44] Carlino writes on the history of pedagogy of anatomy in *Books of the Body: Anatomical ritual and renaissance learning* (1999).

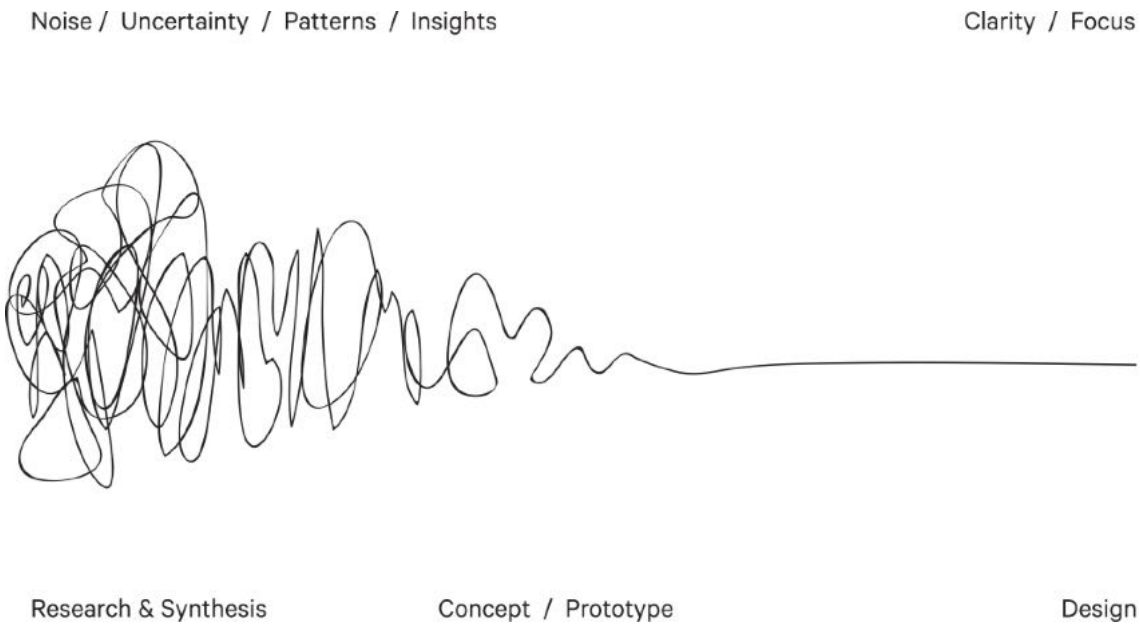

fig.7: The Process of Design Squiggle **by Damien Newman, thedesignsquiggle.com (Newman, n.d.)**

3.2.1. New physical order

Fabrica was a proposal for a new physical order of the body, achieved predominantly through a radical change in imagery. Tools of the anatomist and the artist were used to explore the body, mainly for the purposes of delineating it into parts. Prior to Vesalius there were few books that contained imagery of anatomist's observational work as visually convincing as *Fabrica* (Kusukawa, 2012). The books written by Galen for example contain few images that represent direct empirical evidence of his findings. Due to the religious beliefs of the Galenic era both dissection of human beings and vivisection were unlawful acts (ibid). Much of Galen's imagery used model organisms, transposing animal morphology onto the figure of a human. Galen's engagement with human remains was through happening upon them, as the material of the human body was sacred and for Galen its fragmentation was morally questionable. *Fig.8* shows an image of Galen happening upon a skeleton and observing it for his research.

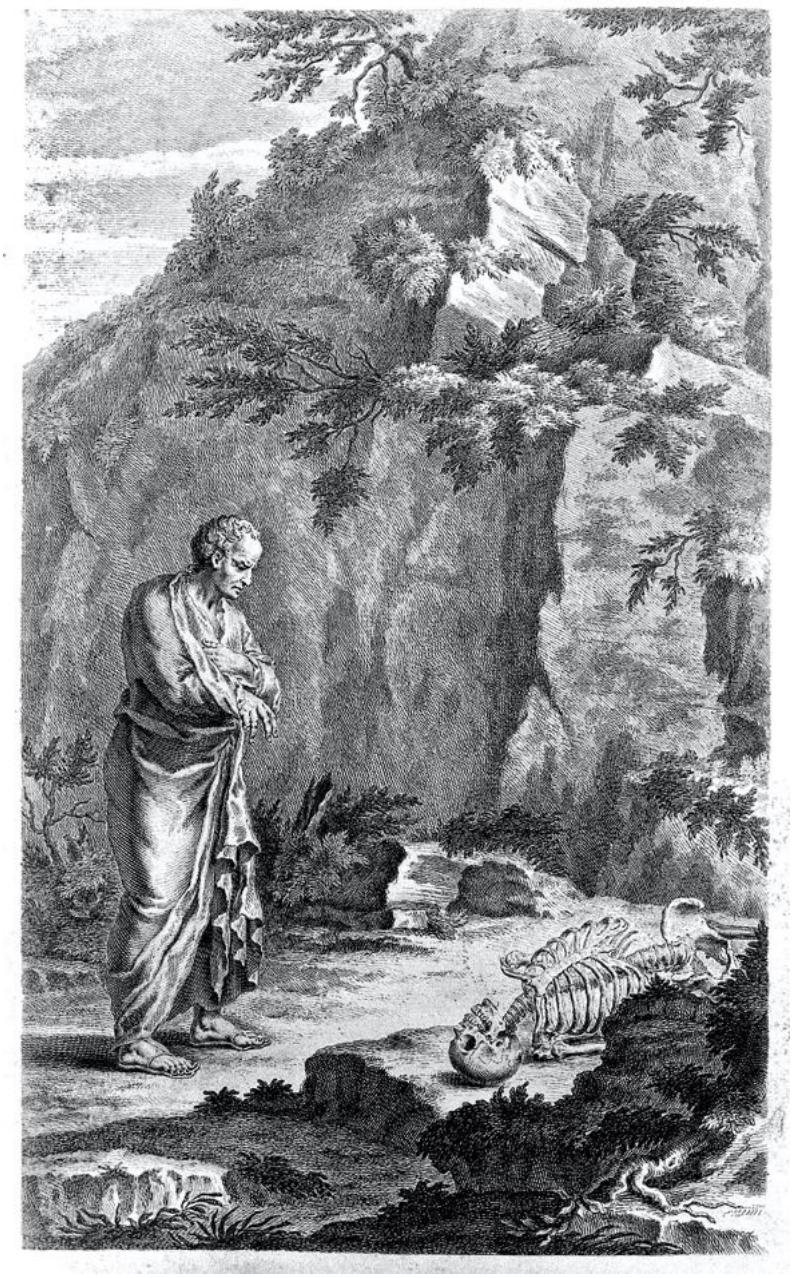

fig.8: **Galen finding skeleton. Wellcome Collection. Attribution 4.0 International (CC BY 4.0)**

Fabrica on the other hand created a colloquy between text and image, the image being the "raison d'être" of this first distinctly anatomical atlas (Daston and Galison, 2007, p.22). According to Kusukawa (2012), Vesalius, among other renaissance 'natural historians,' introduced the compelling "visual argument" (ibid.) at a time when the techne of the image and its effects had yet to be fully understood. The physical order of the body was argued and defined by content of the image, stylistic choices and technical rendering.

O'Malley (1964) describes pre-Vesalian anatomical imagery, such as those representing Galen's work as "transitional" (O'Malley, 1964). As though Vesalian anatomical imagery and beyond has found a more distinct voice as a genre of image making. There are stylistic similarities observable in *Fabrica* and the anatomical atlas' published thereafter. Influences seen in illustrative style, angle of depiction, and graphical elements (Sawday, 1995) seen also in other acclaimed anatomical atlas collaborative works such as *Atlas of Human Anatomy* by Jean-Baptiste Marc Bougery, artwork by Nicolas Henri Jacob (2008), or *Gray's anatomy* by Henry Gray, artwork by Henry Vandyke Carter (1967).

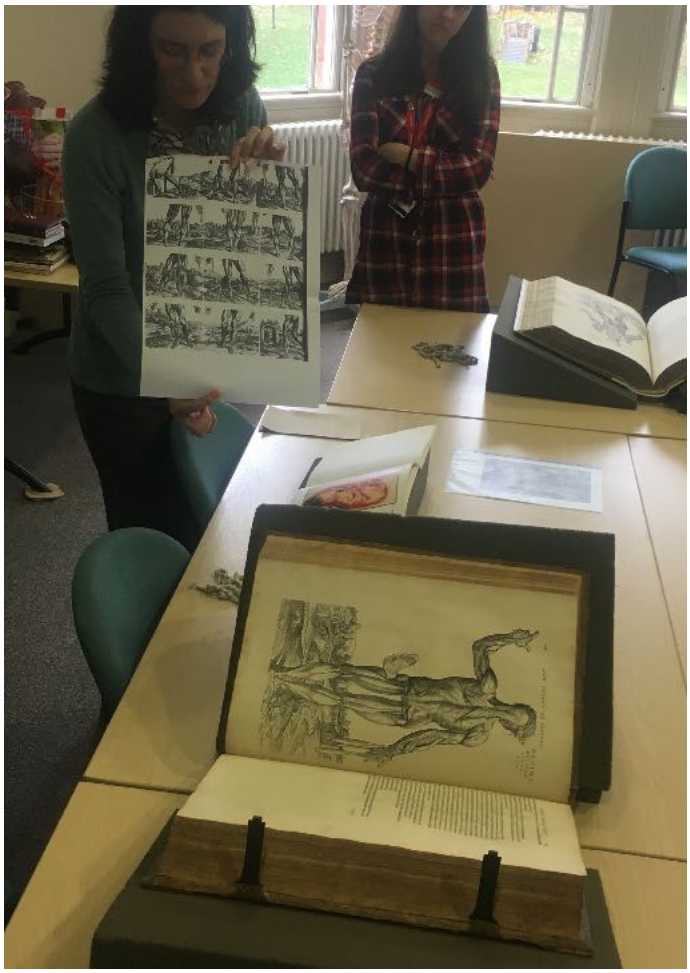

fig.9: **Photograph from visit to Reading University to see *Fabrica* and other anatomical texts during meet up *On the fabric of the human body***

One stylistic decision was to locate the body in context. The full figures in *Fabrica* are not represented as lifeless corpses, they contain features and flourishes that resemble images of the living body. When the tableau of *Muscle Men* (Vesalius, 1543), is positioned side by side, the increasingly flayed and dismembered figures are situated

with ground beneath their feet in a panoramic landscape of the Eugenean hills of Padua and Venice, Italy (the location of much of the research). This can be seen when printed side by side as seen being held in *fig.9*. Situating this model of the body as one with nature in spite of its perceived secular scientific origins. The figures are in choreographed positions; they stand erect in poses that resemble more similarly those seen in a life drawing of a living model[45]. In some cases the full figures are holding parts of their own dissected body, as if to involve them in the process of learning anatomy. In contrast, the few images of Galen appear stiff and rigid. The *Muscles Man* (Pseudo-Galen, Anathomia; WMS 290) of Galen show a flat representation of the human form and many have since been accredited psudo Galen[46]. The figures in Galenic images appear lifeless, perhaps mirroring the context in which this research is usually accrued. The cold, hard, lifeless reference of the body in the state of a corpse may result in imagery that also feels cold, hard and lifeless. Through the living human action of the dismembered body, the reader of *Fabrica* is encouraged to continually create a link between the anatomy of the body and the body as it exists in life. These are not representations of the corpse but rather we are seeing beneath the surface of the living.

Another significant characteristic of the images were that they spoke to artists. The book was also being "issued as manuals for artists and sculptors in the late seventeenth and early eighteenth centuries" (Kusukawa, 2012, p.206). Many of the plates in *Fabrica* are attributed to Jan Steven van Calcar amongst other members of unnamed students of the workshop of Titian, students of the Italian painter Tiziano Vecelli (Kusukawa, 2012). This collaborative visual effort was not only a recipe book for understanding the body and its composing parts for the scientist and philosopher, but it was also prescribing how the body should be observed by the artist. "Not only do images make the atlas; atlas images make the science." (Daston and Galison, 2007, p.22). The consequence of the atlas having such gravitas in controlling "how" the subject is looked at (ibid.) is that it reinforces the idea of this model of the body as

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[45] The stances can still be observed in later 18th century wax modeling, according to Monika v. Düring (2014, p.66) in *Encyclopaedia Anatomica*, "the whole body is felt to be alive – an impression which results from the representation of the human body in typical poses and gestures and complete refusal to depict a dead body". Düring (2014, p.66) in reference to the wax models at Museo La Specola Florence.

[46] Much pseudo Galenic imagery emerged possibly as images that were made to corroborate his work and ideas but were produced after. Showing at this time imagery was becoming an important portrayer of information about the body.

reference material to understand the body in life[47], with images becoming depictions of the truths of science. Rifkin (2011) writes that the stylistic choice of the atlas shapes how we understand the human body through the lens of anatomy. For example, "the renaissance liver – complete with peripheral lobes… – is not the bulbous Baroque liver, and neither resembles the elongated Neoclassical liver" (Rifkin, 2011 p.8). In creating an image of the elongated liver, the mental model of the liver becomes elongated.

The images of the body were made in order to synthesise it. The highly skilled technical woodcuts in *Fabrica* were intended as empirical testimony in ordering the functions of the body.

> Within natural history, drawing became the means through which not only knowledge could be discovered and assembled, by the materialisation of signs, but also one in which knowledge could be constructed as a reflective process of 'see-ing'. (Cachao, 2014, p.339)

The designed model of the body derived from *Fabrica* was an assemblage, the see-ing described by Cachao (2014) was through many eyes. Those of various artists, various anatomists, and imaged from various bodies. The model of the body was being synthesised to represent bodies. As Vesalius attests "I am not accustomed to saying anything with certainty after only one or two observations" (translation in O'Malley, 1964, p.116). The images depicted were what Daston and Galison (2007) might define as "truth-to-nature," that being "the characteristic, the essential, the universal, the typical" (Daston and Galison, 2007, p.20). Its purpose as a book of reference for anatomists during dissection, surgeons in procedures and artists in depictions meant that the atlas was to be used whilst engaging with bodies, therefore the body ought to be 'seen' as how it was visually described in *Fabrica*. Any noticeable differences would dispute the knowledge constructed and challenge the validity of the ideas within. The design of the anatomical body therefore should have a physical order that both links the depictions most successfully to a living body but also appears most applicable across variations to engage in vastly different and multiple enactments.

[47] For example even how to depict the body in life drawing by imagining the musculature or ecorché.

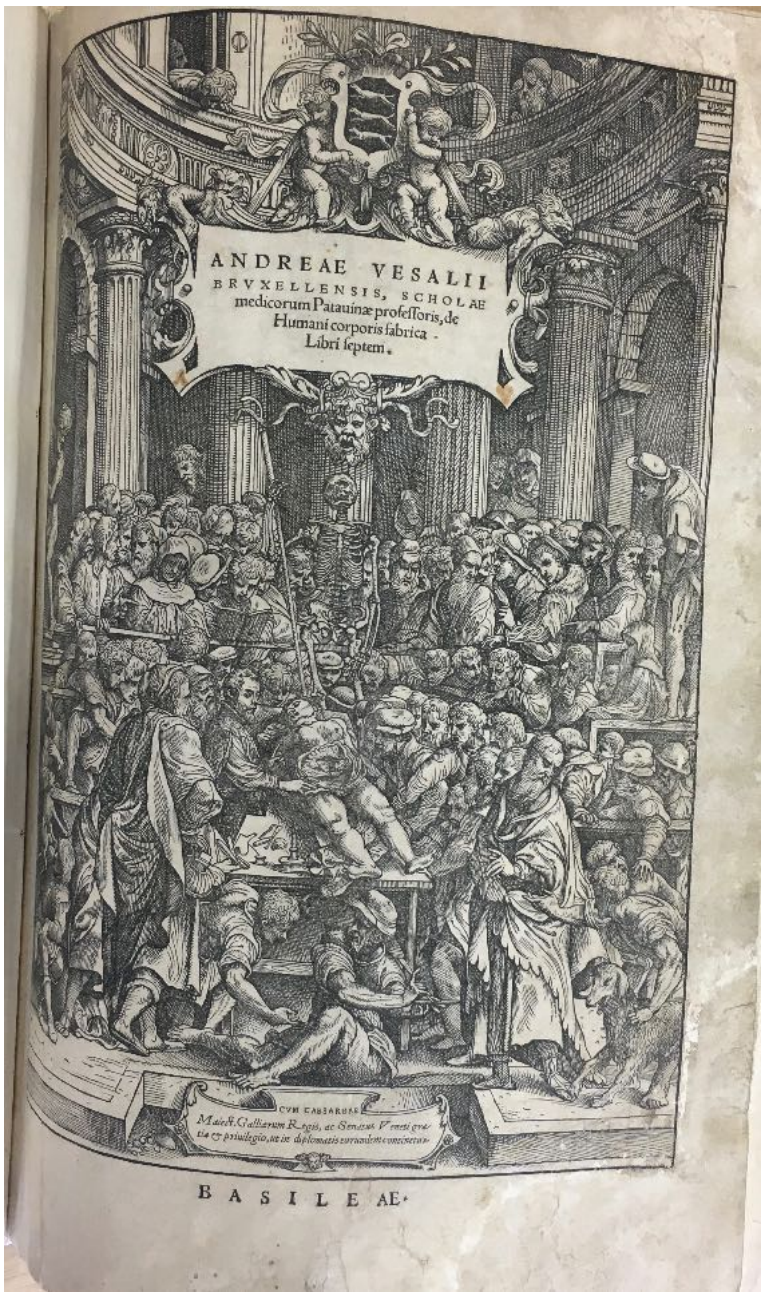

fig.10*: Frontispiece to *Fabrica*. An anatomical dissection being carried out by Andreas Vesalius, attended by a large group of observers. Woodcut, 1543. Photograph from visit to Reading University to see *Fabrica* and other anatomical texts during meet up *On the fabric of the human body

3.2.2. New organisation

To follow the squiggle graph of Newman, Vesalius had used imagery to synthesise the body, the ideas in *Fabrica* then needed to be prototyped "to test the function and performance of a new design" (Marshall and Erlhoff, 2008, p.317). In order to prototype Versalius' design ideas for a new model of the body, he introduced

methodological approaches through controlled performances. The frontispiece of *Fabrica* (1543) is a woodcut depicting Vesalius teaching in the midst of a bustling crowd of onlookers (*fig.10*).

This image arguably is an advertisement for Vesalian teaching methods in which he promoted theatrical hands-on dissection becoming incorporated into the research, teaching and learning of anatomy. The woodcut envisions the Vesalian anatomy lesson, showing how he would teach whilst simultaneously dissecting a human corpse. This is representative of what Andrea Carlino (1999) called a 'shift' from "the epistemological norm that had constricted anatomy for over a millennium." Carlino (1999, p.213) writes about a change in the format of dissection visible in the woodcuts of a number of anatomical books. Images of Mondino de Luzzi[48] for example show him sitting behind a pulpit reading anatomy from a book, as a barber surgeon would act out the dissection and an ostensor would direct the eye towards the parts of the body and book in support of the academic anatomist. The relationship between the anatomist and the body was "no longer ostensive but rather presentative or performative" (Wilson, 1987, p.69). Vesalius used these public events as an arena to prototype his model of the body using an audience.

According to Houde and Hill (1997) numerous prototypes can be created to test a design idea. They suggest three ways that "prototypes prototype" (ibid.). First is the *role prototype*, "to investigate questions of what an artefact could do for a user" (House and Hill, 1997, p.379). This model of the body promoted "the craft of direct observation based on human dissection" (Vesalius and Garrison, 2015, p.i). In the frontispiece of *Fabrica* a variety of people are in attendance promoting the interest in Versalian ideas across vastly different people. The model of the body, as Vesalius designed it, should be of interest to; the religiously inclined, the academic, the philosopher, the artist, the pauper and even the dead, all of which are pictured in this woodcut.

The second is the *look and feel prototype* "to explore and demonstrate options for the concrete experience of an artefact" (Houde and hill, 1997, p.379). Vesalius encouraged his students to actively participate in dissections, and for those who had (as

[48] Mondino de Luzzi published one of the first books on anatomy based on dissections made directly from a human cadaver.

many did) limited access to dissection material his book ‘Epitome’ contained figures with ‘cut out’ internal organs that could be removed and reassembled, much like the three dimensional anatomical figures that now adorn the rooms of most medical education establishments (*fig.11*). This was to show that the dissection specimens of the body both looked like they were imaged and felt like they were described verbally in *Fabrica* and in Vesalian dissection events.

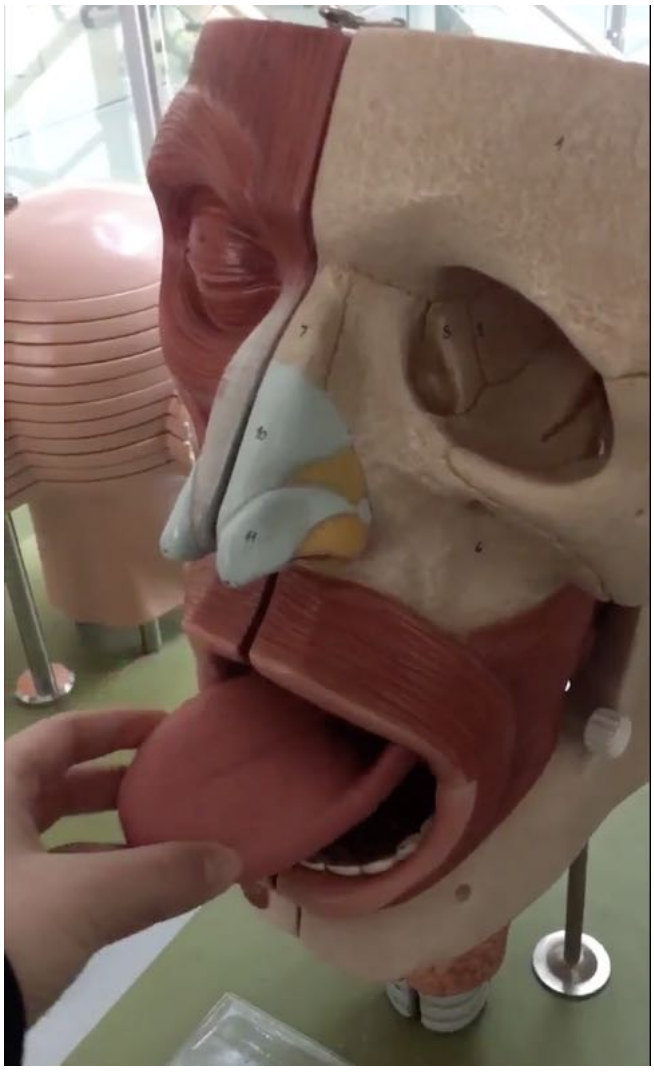

***fig.11*: Oversize anatomical figure in Peninsula Dental School Plymouth University**

The final is the *implementation prototype* “to answer technical questions about how a future artefact might actually be made to work” (Houde and hill, 1997, p.379). In trying to prove the errors of his predecessors, Vesalius (1543) would often dissect a human and animal side by side to highlight the differences that had been deduced in the human anatomy from the dissection of non-human material. According to Magner

(2002) this initiated the study of comparative anatomy, through disproving previous practices and affirming his own techniques for future use. For Vesalius (1543) this was proof that his proposed model exceeded existing models.

The prototyping events were proof of concept for audiences. Vesalius used these performances to make clear his valid engagements with the human body enacted through hands-on dissections with human cadavers. Prior to Vesalius dissections were demonstrations that fit the narrative of ancient texts (Carlino, 1999). Versalian methods introduced a change in the purpose of dissection, the dissection and the theatrics associated with it became a prototyping event which proved evidence of living anatomy. Truth was not solely in the text, but also in what was observed in demonstration. Returning to Alexander's (1964) description of a design process, the body is organised through reaffirmation that the parts are where Vesalius promises they should be as described within the imagery of his publication and theatrics of his performances.

3.2.3. New form

Vesalius' work has been described as a "reform" of anatomical science (Kemp, 1996). His research and synthesis; concept and prototyping mentioned above left a design outcome which reformed the body as we know it today. The design outcome of interest is not housed solely in the materialisation of the visualised thought on the pages of *Fabrica* or in the viscera of dissection specimens on the slab. The anatomical body is as Thacker (2001) would say enunciated performatively in the "space between". The performance is what negotiates between the anatomical body and body of anatomical knowledge (ibid.). For designers form is not always described as the concrete production of the artefact, instead it can also be its "dematerialized conceptual sibling" (Erlhoff and Marshall, 2008, p.169). According to Erlhoff and Marshall for designers "Form is shape organized in the service of content" (ibid., p.169). Therefore the reform, reimagined through the lens of a design project, was not just altered in the radicalisation of the new physical order of the image, or the new organisation of methodologies but in defining and permeating the content. In other words it was the transition of knowledge about the body that took a new shape.

For Vesalius his goal was at the end of Newman's squiggle, to create a model of the body that had clarity and focus. Magner (2002, p.74) suggests Vesalius was close

to "describing the body as it really is." The model of the body created by Vesalius was a successful description but not of the body wholly. The updated form of the body as it was designed in *Fabrica* is a constructed version of a select division of the human body which in the case of this model separates it into "an organised collection of skin, bones, blood, organs, nerves, and fluids, made up of various chemicals, all interacting together" (Johnson, 2008, p.669-680)[49]. This view is what Johnson describes as the "biological body" which is just one part of the human body. The biological body is the living, functioning mass of flesh that functions as a biological organism. For Johnson this view is reductive and disregards other elements of the human body; the ecological body, the phenomenological body, the social body and the cultural body, which amalgamate to form the human body. The design for the body that is created in *Fabrica* is different to those described by Johnson; it is the anatomical body. Unlike the other body constructs the anatomical body is a simulacrum of the biological body generated through the visual arguments and prototyping events of anatomical study. The anatomical body perpetuates a reductive vision of the body as a thing (Johnson, 2008), a functioning machine, it is reduced to purposefully redact the other parts of the human body which Johnson describes[50]. This is not to say that the anatomical body is an ersatz body, it has been an advantageous description of the human body in many ways. Although its borders become stricter. The anatomical body has elements that become right and wrong, healthy and pathological. Through its redesign it has eliminated the complex and messy, and in doing so can also lose nuance, which when used as a reference for design can make designing simple, but implementation problematic. Made clear in the figures of Joe and Josephine above that take reference from anatomy, they create defined and simplified constraints for design, however, those designs are not applicable to everyone.

3.3. Establishing the Datum

> 'normal science' means research firmly based upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation for its further practice. (Kuhn, 1970, p.10)

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[49] Johnson (2008) calls for a non-dualistic and embodied view of constructing meaning as it is mediated through the human body.

[50] Vesalius for example aimed for less devotion to "rhetorical polemics" (Vesalius and Garrison, 2014, p.i) in favour of observational science which although additive removed aspects of the study of the body in favour of others. Creating a hierarchy of knowledge about the body.

Kuhn (1970) describes the setting up of traditions in science through paradigms which stick for a time then shift in "scientific revolutions" (Kuhn, 1970). The revolutions involve ideas forming to create a structure, those ideas are then disputed and finally new ideas with new structures take their place, creating a loop. The foundation for continued research and practice is what Kuhn describes as enforcing a paradigm. Vesalius' work set up a paradigm in which he facilitated establishment through invitations to contribute. In *Fabrica,* one particular muscle is purposefully not represented as, "it was impossible to show its shape appropriately" (translated in O'Malley, 1964). It seems the decision to not include this muscle affirms the atlas as the manual for correct visual representation of the body. As leaving its appearance abstract means that the knowledge surrounding it can also be abstract and not made concrete through its imaging. His decision also to include large margins allowed the space for others to add notes to his works, these open ends set up opportunities for others to build upon and resolve (Vesalius and Garrison, 2014), enforcing the paradigm.

For Kuhn the revolutions have "drastically restricted vision" (Kuhn, 1970, p.24) although without the dogmatic belief in them the investigation of nature would not exist at such fine detail. The rules enforced during paradigmatic plateaus often remain the backbone of the science from which appendage ideas can cling and reinforce. The establishment and distribution of the datum of the body made in anatomy has consequently set up how the body has been dealt with, leading to worthy insights but also significant pitfalls.

> The approach used by normal science to manage complex social and biophysical systems as if they were simple scientific exercises has brought us to our present mixture of intellectual triumph and socio-ecological peril. (Funtowicz and Ravetz, 2003, p.1)

It is not solely the anatomist that has preserved the primary references of the body as anatomical ones. The anatomical body has remained relatively accessible to many other professions. To name a few, for example, clinical psychology is concerned with the structure of the brain, weightlifting is concerned with structure of musculature and makeup artists are concerned with the contours of the face, differing disciplines with ideas taken from the datums of the anatomical body. In looking towards other professions it is clear that it is not necessarily sustainable to only have one model of the

body. For example, in 2015 the average rugby player[51], an athlete usually considered healthy, would measure obese on Body Mass Index charts[52]. If the anatomical atlas is a reference to which all anatomy is guided, any deviation from this may be considered pathological. Those anomalous to the norm are considered faults, regardless of the impossibility to fully conform to truth-to-nature. Some determinants inform the anatomical body more than others, but the dominant view of health and well-being has to be tempered[53]. The escalation of this model in favour of its anatomical roots promotes a hyper-anatomy, as it is critiqued and used it becomes concentrate. Reinforcing the paradigm; it becomes the datum, a reference point for all.

3.3.1. Creating blueprints for the norm

The negotiation between the anatomical body and body of anatomical knowledge that Thacker (2001) mentions above is forever in motion. The basis of anatomical study was, and still is, to understand the material and structure of the body, what it is composed of and the relationship between its components[54]. Anatomy deals with the material culture of the body, its form, weight, size, shape and consistency of parts. Over time parts have changed and updated, knowledge from previous iterations of the anatomical body are not disregarded, they are disputed and new elements are added or take their place, but the scaffold of anatomy has remained concrete since its inception and wide distribution at the time of *Fabrica*.

For centuries cutting has been the primary method to negotiate the anatomical body. In the time of Aristotle, when the reverse engineering of the body first became anatomical study, anatomy quite literally meant, I cut up. Post-Vesalian anatomy as an observational science has continued to rely on the various crafts of cutting in dissection. The tools used for dissection inform the knowledge produced from the dissection itself.

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[51] Taken from data of the New Zealand team in 2015 (Rhys and Bywater, 2018) heights and weights have drastically changed over time. Average height of 186.5cm and average weight of 104.4kg.

[52] A chart that distinguishes normalcy of healthy height and weight ratio.

[53] Like tempered glass the anatomical body is manipulated for safety; being toughened towards medical uses. Although it is hard to rework into another format.

[54] Anatomy has a physical component that distinguishes it from physiology, which is the study of how those parts work.

The tools, as Hodder (2012)[55] would believe are inseparable from how we comprehend the body. “The human physical body is as it is because of its interaction with things” (Hodder, 2012, p.37). Lack of cadavers for research has always been a consistent complaint of the anatomist[56] but principally lack of appropriate tools to exploit obtainable materials is more impactful to attain information hidden in the minutiae. In comparing the types of dissection knives illustrated by Nicolas Henri Jacob (*fig.12*) with the knives wielded by Vesalius depicted in *Fabrica* (*fig.13*) it is clear which tools may be more appropriate to delicately separate muscles from ligaments or find the intricate paths of the vascular system.

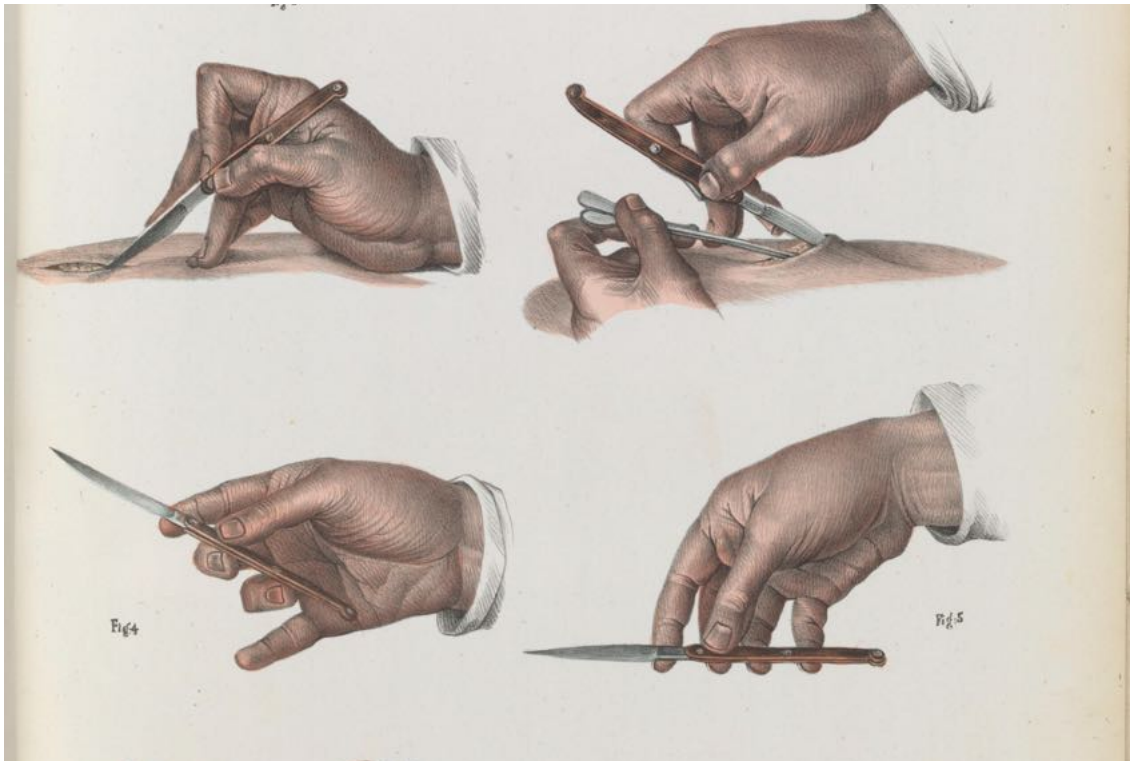

fig.12: **Illustrations by Nicolas Henri Jacob of scalpel wielding techniques in Atlas of Human Anatomy and Surgery. Iconografia d'anatomia chirurgica e di medicina operatoria / [Jean Baptiste Marc Bourgery].. Credit: Wellcome Collection. Attribution 4.0 International (CC BY 4.0)**

[55] For Hodder (2012) humans do not only depend on things but humans are things in that they equally are shaped by the things around them in a complex exchange. Holder argues for a study of materiality that is not just about things separated from the body but also the body as a thing that is in dialogue with its environment of objects.

[56] Take the grave robbing of Burke and Hare into account in trying to access bodily materials for dissection, the skeleton of Burke, a book made from his skin and a letter written from the blood of his head are on display at the Edinburgh Surgeons’ Hall Museum as a form of shame for his crimes.

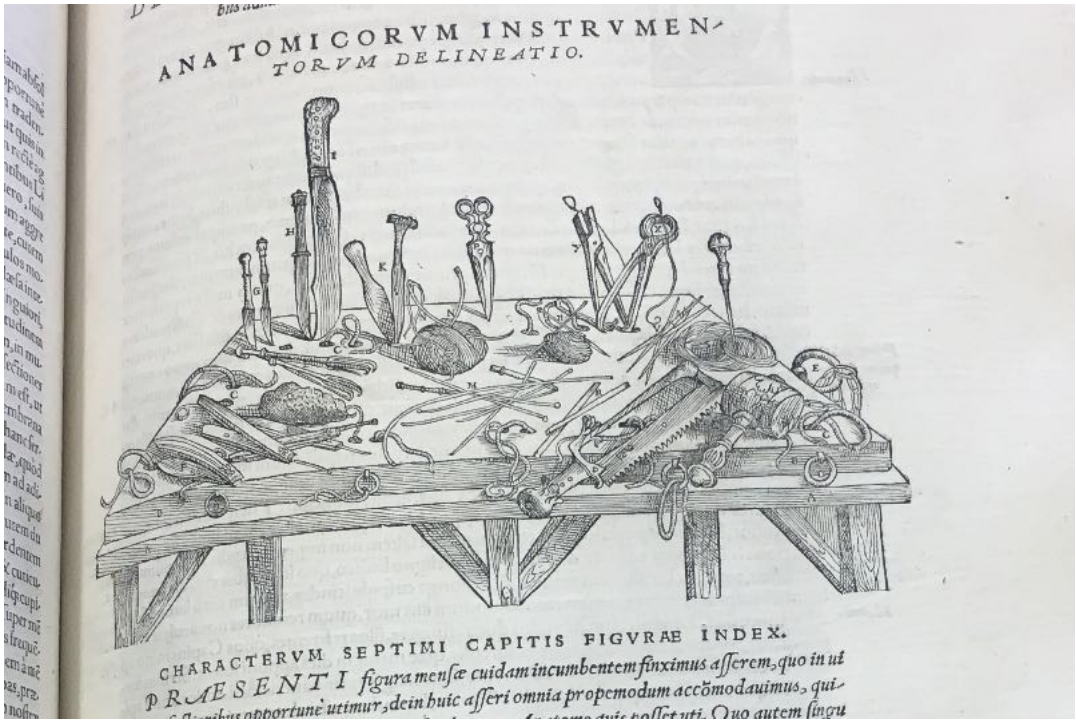

fig.13: **Illustration of dissection and surgeons tools. Photograph from visit to Reading University to see *Fabrica* and other anatomical texts during meet up *On the fabric of the human body***

How the body is engaged with therefore shapes the models of it. The production of tools with specific functions amassed in parallel with knowledge of parts of the body. Michel Foucault's (2003) concept of the "medical gaze" suggests a perception of bodies filtered through medical and clinical systems, such as tools to understand the body, can be the cause for a patient's identity to become separated from their body. These two parts of the patient are treated with different values and exist as dichotomous models. As in Mol's Body Multiple (2002) this creates separate visions of the patient that may have been informed by anatomical study. According to Foucault (2003) the engagement and study of the body as a corpse, was a particularly potent driver for the creation of disparate attitudes to the patient's body and environments.

> At a very early stage historians linked the new medical spirit with the discovery of pathological anatomy, which seemed to define it in its essentials, to bear it and overlap it, to form both its most vital expression and its deepest reason; the methods of analysis, the clinical examination, even the reorganization of the schools and hospitals seemed to derive their significance from pathological anatomy. (Foucault, 2003, p.124)

The division of the body is synthesised by Hannah Drayson (2011) using the analogy of a cake to describe how new realities of the body are created via instruments defining those parts through cutting the cake. In making a cut, the cake is "open to different discourses of contrast and distinction" (Drayson, 2011, p.53), and this imposes meaning on those parts. In doing so new bodies are created that have different form, function, purpose and meaning[57]. The atlas, tools and other determinates are conditions through which to view the body and in which the anatomical body is manifested.

fig.14: **Gerrit Lamberts (1812) Guillotine poor de Waag**

3.3.2. Artifice of the body at the Waag

> Villains, obnoxious to the human race while alive, become useful when dispatched. Medicine seeks advantages even from death. The speechless skeleton, the lifeless limbs, all teach us that we should avoid such shameful fate. Head, brains, tongue, heart, lung, kidney, bones, finger, hand can teach the living some lesson. Spectator, learn here to discover your own self. And as you look over all this evidence, rest assured, that even in its smallest part, Godly Might lays hidden. (Waag, n.d.)

During my fellowship at the Waag Society, I had the opportunity to sit alone in the Theatre Anatomicum; the atmosphere is weighty with history, and rich with both the

[57] Drayson's thesis on Gestalt Biometrics offers an in depth account of the role of instrumentation in constructing the body.

fear and exhilaration of medical innovation. Over three hundred years ago criminals would be executed in the square outside (*fig.14*) and their fresh corpses would have been brought through the doors of this castle-shaped anatomical and masonry school. Placing the body in an economy in which its physical medium was (and still is) sought after and transferred as goods. This act gave value to the once troublesome members of society who then "become useful when dispatched," (Waag, n.d.) these words, reminding us of the worth of dissection, still stand in gold and oak placard around the walls of the theatre.

fig.15: **Rembrandt van Rijn, (ca. 1632)** ***The Anatomy Lesson of Dr. Nicolaes Tulp***

The Theatrum Anatomicum is an octagonal space with wood panelled walls and floor. The architecture of the room is typical of other anatomical theatres of the era[58] in that the walls are high and close together. Therefore when it was functioning as a dissection room, many viewers could sit on cascading seating allowing them to view live dissections in detail without visual obstruction. On one wall hangs a large print of

[58] Similar architectural traits to the anatomical museums of University of Padua, Uppsala University, Museum Boerhaave and Leiden University.

Rembradt's painting *The Anatomy Lesson of Dr. Nicholaes Tulp,* (*fig.15*)[59]. On the domed ceiling are the original paintings of the crests of the surgeons' guild, the pinnacle of which being that of Professor Frederik Ruysch.

The Waag was a space where the body had become hyper-anatomised. Vesalius' design for a new model of the body had solidified his fame as one with significant skill and wisdom to know the body and dissect it in the correct fashion. In seventeenth-century Holland celebrity anatomists and imagers of the day still perpetuated the Vesalian scaffold of anatomy through ever finer and intricate techniques. Ruysch's innovative embalming techniques are still visible in his surviving specimens. The more intricate the detail achieved by Ruysch in his dissections meant higher likelihood for fame as an anatomist and greater chance for new findings. "Ruysch's talents revealed and rivalled God's own superhuman handiwork" (Hansen, 1996, p.674), the skill level of hand cutting had reached climactic heights. To feign further skill in craft of dissection a paradigm shift in imagery occurred "whereby the narrative of the anatomy lesson was fictionalised and aestheticized" (Hansen, 1996, p.663). Artifice in the imaging of the anatomical body was seen in both the work of Ruysch and the anatomy lesson genre of painting[60] to represent the skill that was no longer possible by the human hand alone.

As Charles Bell writes "[W]here the demonstration is presented to the eye . . . knowledge is most easily conveyed" (1821). Ruysch successfully manipulated what was presented to the eye in order to enhance the vision of knowledge. In his collection catalogue Ruysch was more often referred to as an artist (Hansen, 1996). His intricately made vanitas, made mostly of foetal specimens, surrounded by anatomical paraphernalia such as wax filled blood vessels, dissected kidneys, bones and botanical specimens were exhibited to the public as science performed[61]. His work was beautified, in order to allure the gruesome fascination of the public who were in fearful awe at the moral questions raised by revealing the secrets of the body[62]. He employed

[59] The inspiration for the title of *The Anatomy Lesson* work, so as to situate amongst other works of this genre.

[60] Multiple depictions in paintings of anatomy lessons surfaced at the time, giving the practice gravitas as moments events of importance.

[61] Ruysch exhibited his work in a library and exhibition space that was open to the public.

[62] "even death itself is afraid" (Hansen, 1996, p.675) Ruysch would include text and poetry with his vanitas to make moral questioning evident in his work.

techniques that seemed as though his specimens were being kept alive. By using coloured wax to add flush to otherwise pale corpses, and by dressing wet specimens to make them appear as though they are frozen in time[63], as a reminder that they were once alive.

The wet specimens with accoutrements are uncomfortable to look at. Looking closely at the jars (*fig.16*), the decision to adorn them in beading and fabrics is most likely a strategy to hide unsightly cuts. To hide the seams is also a sculptural strategy of realism to make objects appear more similar to the living, real depicted object. Concealing the issues was a stylistic choice that made it appear untampered with, elevating Ruysch's cutting work.

fig.16: **Professor Frederik Ruysch (1638-1731), Child's head with Turkish cap, ca. 1720, prepared child's head, textile and feathers, Bleulandium Museum, University Medical Centre, Utrecht. (Photo: Bleulandium Museum, University Medical Centre, Utrecht)**

[63] The specimens of Ruysch were exhibited in De Gezonde Mens next to my work Transfigurations by Sabine Wildurvuur in order to create a tie between technologies of the past and the future of innovative medical technologies. To see my work contextualised amongst these incredibly iconic specimens made the heritage of medical imagery clear in using tropes of past representations in imaging the future.

The image commissioned on the wall at the Waag by Rembrandt (*fig.15*) also perpetuates an artificial vision of anatomical practice. The members of the surgeon's guild, who paid to be included in the work, appear incredibly engaged in the important act of dissection. Like the Vesalian frontispiece this image is a constructed vision of how science should be perceived. The image is depicted in a similar way to imagery of historic events, giving gravitas to this way of working with the body that was less accessible to everyone. Unlike Vesalius, it only involved the privileged and the skilled. The work has a facade of artifice, arguably it does not depict a realistic representation of how a dissection would take place (Hansen, 1996). The dissected arm is clear and sharp and not oozing with messy fluids on the white cloth (similar to those I experienced in my visit to Erasmus). This shows the artistry involved in dissection of clean and skilful cutting techniques.

The era of imaging hyper-anatomy that occurred at places such as the Waag reveals a drive to gain access to the body in ways that were beyond human capabilities. In *Mechanisation Takes Command* by Siegfried Giedion (2014) considers the intertwining relationship between mechanisation and the human body. Giedion describes the increasing level of refinement of tools that replicate what the hand can do and then to eventually better what the hand is capable of. After this period at the Waag, a linear trajectory has been followed in anatomical study. This is a strive for tools and techniques that could achieve the goal of finer and finer exploration of the body beyond hand techniques. An achievement made admirable through the creation of models that appear highly refined, a depiction of anatomy as it was found at the Waag.

3.4. To cut finer is to know more

Anatomy is understood through appearances, this is made clear through its imaging in *Fabrica* and its representation at the Waag. Anatomical study is concerned with ordering the body into parts, through differentiation and delineation defined by appearance[64]. Connectivity, material consistency, colour and form can be the cause of separating one tissue from another. A cross section reveals strata of diverse materials, visibly different to the eye and tactually separable by the hand. The success of

[64] The *Terminologia Anotomica* (Unifr.ch., 2020) is the current international standard book on the nomenclature of anatomy, defining the names for specific parts of the body and technical terms associated with its form.

separating and dividing body parts developed with the increasing armamentarium that supported finer and more discrete division beyond what the naked hand or eye could achieve. John Kirkup (1995) writes an extensive history of medical development through tools and instruments in relation to surgical and technological change[65]. He outlines how the parts of the body have been defined, explored and healed across history through tools from the "fingernail to ultrasound" (Kirkup, 1995, p.189). In *Evolution of Surgical Instruments* (1995) he posits that the study of surgical instrumentation is a method of studying the history of surgery in general. The exponential growth of surgical tools and products outlined by Kirkup further cements the anatomical body as one that is understood through appearances. The tools facilitate both separation and reconnection between materials that share visible and material properties.

3.4.1. Scalpel

There is a coalition between armamentarium of the anatomist and the designer. These tools are in dialogue, for example the scalpel might guide the pencil across a page, but the line marked in the atlas is also a guide that defines where to make a cut[66]. These tools have been shared and developed together. Referring to the Swann-Morton surgical blade product overview chart (swann-morton.com, n.d) there are numerous blades designed for different cutting that are also sold as non-sterile for craft use. In particular the Swann-Morton category of 'standard surgical blade' No.3 handle with No.10A blades is a typical product of most art and design retailers[67]. Not only do anatomical dissection and design share similar tools but they also share a material process through the use of those tools, which is to try and understand the world through interaction with materials. The scalpel blade and the pencil are tools that act as conduits to access this knowledge in the case of both design and anatomy; they are objects that

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[65] Kirkup (1995) uses the term surgical to also encapsulate tools with different purposes such as those used for anatomical study and autopsy. Although the tools of pathological anatomy and surgery may vary slightly in use and treatment, many are used for the same purposes, tools of surgery are usually trialled in cadaverous research and anatomical centres in the UK for example at institutions such as The Wolfson Surgical Centre. In my visit to the anatomy laboratory at Erasmus MC in the Netherlands a group of researchers were testing a new design for an electric bone saw, a tool being trialled for use in surgical procedures in the context of a cadaverous research lab.

[66] The scalpel and pencil here are used as examples of this interaction there are other tools used for this to a lesser degree.

[67] For example London Graphics Centre stock unsterilised no.3 handle and no. 10, 10A and 11 blades.

mediate interaction with the body. One of the grip types for holding a scalpel is known as the pencil grip, showing that the interaction is also from a shared choreography using pressure and motion to make a slice or a mark. Roger Kneebone (2005) argues that the act of drawing enhances the act of surgery, suggesting the act of physically making and doing are integral aspects of a medical curriculum. His recent proposition that a revival of creative studies at school will enhance surgical dexterity comes from a drop in tactile knowledge from those predominantly taught through digital media. His argument shows not only that a material access to the body is important to gain knowledge but also that the tools used to do so have an impact on what information we take from this interaction. Although the tools of anatomy may not, as Bachelard (1985) would suggest, be wholly responsible for creating the phenomenon of the anatomical body but might instead be part of the larger system of anatomy[68].

The most recognisable and enduring tool of dissection and surgical practices is the knife; the knife is perhaps one of the oldest tools known to man. Incisions once made by teeth and fingernails were exchanged for blades made from wood, leaves and flint (Kirkup, 1995). The copper knife from 3500BC became the first in a long linage of metal blades that lead up to the surgical scalpels of today and beyond. The form factor of the knife has developed through numerous iterations informed often by ownership of the blade[69]. For hundreds of years surgeons owned their own preferable knives, which over time became embellished with flourished features and expensive handles. Many kept the general shape of a mostly convex blade and still remain to be one of the most integral instruments in any surgical procedure.

The knife makes the materials of the body discrete from one another. Kirkup (1995) describes five different categories of blade types and how their material and form have compatibility with different tissues of the body. For example the Bard-Parker two-part scalpel revolutionised cutting techniques through the design of disposable blades complimentary for cutting different materials (Kirkup, 2005). Modern designs for knives may make this interaction between materials even more sensitive. For example the *iknife* (Wong, 2013) is a blade designed to test the vapour emitted by

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[68] Bachelard (1985, p.13) *"Now phenomena must be selected, filtered, purified, shaped by instruments; indeed it may well be the instruments that produce the phenomenon in the first place."*

[69] Robert Liston the Scottish surgeon known for his skilled amputee work (Haines, 2018) created a product line of knives called *Liston blades*. His knives were nickel plated to avoid rusting.

bodily materials it comes into contact with in order to remove tumours. The knife, in any format, responds to the various resistances of the body and in doing so further compartmentalises the body through what the instrument affords.

In Bougery's *Atlas of Anatomy* (2008) the scalpel grip plate shows the type of hand positions needed to make accurate cuts using a folding blade (*fig.12*). As the anatomist would describe and introduce the ventricles of the heart, the scalpel and pencil are the tools that would reveal it. Creating tools that may assist finer cutting and imaging comes with it the prospect of revealing intricacies of the body that may not be visible at the gross anatomical level[70]. Therefore there is a proliferation of tools, each designed to cut and image finer than the last, in order to offer some previously unknown jewel of knowledge at the micro or the nano scale[71].

3.4.2. Microtome and Scanner

The strive for finer cuts has been a valuable method in understanding the body up until now. The method of cutting finer has helped build invaluable strategies for the dominant view of health and wellbeing. For example, it has helped people understand the stages of growth of a foetus in the womb and reduce the likelihood of infant mortalities, or to delineate the removal of growths to prevent the spread of cancer. It is the basis to which arguably all medical knowledge has been founded and structured. As the basis for pathological study mentioned in Foucault's *Birth of the Clinic* (2003) above (3.3.1.). The success of this method validates one way of looking at the body, discouraging other models of the body to come to the forefront. The momentum creates a challenge for the intersection of alternative interventions, which may otherwise appear radical in their implementation into science.

Even the profound shift of *Fabrica* contained aspects of previous anatomical texts that would situate the book in an understandable format, yet contained elements of updated techniques and ideas that pushed it away from the previous visions of anatomy. In design terms, the struggle to diverge from the systems of anatomy currently in place may be likened to Raymond Loewy's 'MAYA' design principle (1951). 'MAYA' meaning 'most advanced, yet acceptable' in which he refers to designs which are

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[70] Gross anatomy or macroanatomy, is regarding what is visible from the naked eye.

[71] Microanatomy, is the study of anatomy at the micro level, for example histology is the study of the anatomy of the cell.

effective in pushing boundaries, yet are tethered to comprehensible reference points in ways that makes them more acceptable by society. Therefore the method of cutting offered a reliable means for understanding the body which research has not significantly strayed away from.

In order to generate a finer slice than what was achievable by the knife, came the design of the Microtome attributed to anatomist Wilhelm His (Hopwood, N. 1999). As tome means to cut, microtome indicates an extremely small cut. The microtome was an evolution of the knife. Similar to a meat slicer, the microtome could slice specimens in sections measurable to the micro or nanometre; with the slice being consistent in thickness in ways that would be challenging to achieve for a hand and scalpel. The Microtome shares design characteristics of film technology. The specimen would be preserved in salts or later in a wax block, sliced using a secured blade and the sliced section placed on a slide, in some cases the section would be distributed on to motion picture film to then be observed in projection[72].

The change in the control of the cut raised questions about reception of the image once processed through the slice. The microtome "gave body" (Hopwood, N. 1999) to dissected specimens, not only in three dimensional shape but also gave body to the views of the anatomist. His aimed to proliferate the use of physical artefacts and collaborated with sculptors to generate wax figures and three dimensional imaging techniques. The microtome supported knowledge produced through cutting but introduced a mechanical objectivism (Daston and Galison, 2007) which distanced itself from the "seeing" that Cachao (2014) mentioned earlier in the reflective act of drawing. As the microtome eliminated the craft of the knife and the pencil, its invention democratised morphology, causing discomfort for those involved in imaging natural sciences (Hopwood, N. 1999).

> the next generation of 'scientific zoologists' will know only cross-sections and stained tissues, but neither whole animals nor their mode of life! (Ernst Haeckel in (Hopwood, 1999, p.476)

Haeckel's grievance was that removing the subjective elements from imaging was a risk that could drive "ideas out of science" (Daston and Galison, 2007, p.191). His' intent was an objective visualisation that removed the anatomist from the equation in making

[72] A diagram of this can be seen in figure.27 of p.92 – p.93 of 'research films: in biology, anthropology and medicine.' By Anthony R. Michaelis (2012)

the image, the artistry in the knife work of Ruych, for example, would be depersonalised and mechanised through the blade of the microtome.

The microtome was an accessible tool even for the unskilled hand, this meant that both hand and mechanised cutting became the modus operandi for anatomical study. Once again the microtome became subject of redesign to generate an increasingly fine slice, resulting in ultramicrotomy, to make samples as thin as twenty nano meters thick to be viewed on a scanning electron microscope (SEM) or transmission electron microscope (TEM)[73]. It seems that once the limits of cutting are met, finer forms of cutting are introduced as a means to continually attain information. Barry F. Saunders (2008) writes about the different kinds of cutting achieved by a Computed Tomography (CT) scanner, a machine that he describes as cutting through space rather than mass. He makes a comparison between cutting for pathology and the spin cutting of a non-invasive slice. Although the CT scanner does not make an incision, the cutting still bares resemblance to his description of slicing in a morgue, in that the computer processes the images in segmental slices and like the microtome those slices are set equally spaced in a uniform direction[74].

As part of the Bio Art and Design awards I had the opportunity to have a diffusion tensor imaging (DTI) scan at Erasmus MC Rotterdam with Marcel de Jeu and Jos van der Geest (*fig.folio39*) (Haines, A., Jeu, M., Geest, J., 2015). This machine records signals in slices of the body, forming a digitalised three dimensional image similar to the microtome but of a living body (in this case mine). We translated these images into digital files that could read the density of the materials of my head (*fig.folio36*) and also the main connections in my brain. Otherwise known as a connectome or a map of neural connections (*fig.folio41*). I then used a program (OsiriX) which could read the slices from the DTI scans, creating a digitalised 3D image of my head and brain. I cut through the image on screen and recorded a film of my head slowly being dissected. It is an uncanny experience seeing your body digitally dissected (*fig.folio42*), when the procedures of dissection are historically performed on corpses (as detailed above). A strange aspect is recognising yourself in the image, again when

[73] With thanks to Georgia Rhodes at NatureLab Rhode Island school of design for a SEM induction in their lab.

[74] The CT scanner cuts in three directions called Axial (Transverse), Sagittal and Coronal.

images of anatomical bodies are made in truth-to-nature they do not retain the characteristics you are accustomed to seeing in the mirror. After this experience my collaborators helped create a program that could somewhat replicate the function of my brain and implement this into an interactive object. This was the basis of the project *Drones with Desires* (annex: Portfolio), a collaborative effort between myself, Marcel de Jeu, Jos van der Geest, Sean Clarke, Jack McKay Fletcher, Christos Melidis, Marcel Helmer and Vaibhav Tyagi (as well as feedback from many other CogNovians, particularly Thomas Collins and Francois Lemarchand) to create a drone which worked using brain data. The work consisted of a flying sculpture which was sending information via echolocation sensors remotely to a computer and dropping these inputs into an artificial neural network based on the aforementioned brain scans. The network would update based on an evolutionary algorithm which had a randomised preference for comfort, balance and curiosity[75]. The romanticised vision of this work was that it might retain characterises of my brain from the scan, floating around the gallery questioning if we are indeed just a sum of our neural networks or as Gilbert Ryle says "the ghost in the machine" (1949). In reality the drone was such an ambitious challenge in a gallery space, that when it was working it was difficult to tell if it was doing as we predicted. The compelling result of this work was the process of the collaborative effort which extended far beyond the making of the design work itself. The drone, much like the microtome section objects was a breakdown of data from my brain restructured into another form, one that is almost incomparable to the first. Through making this work it was clear that the more the body was processed the more it was corrupted from the original. The processing seems to also be a form of cutting where data, and nuance is lost and different data and nuance is added. The anatomical atlas of the body shifts and changes as we negotiate it through the lens of theories, techniques and technologies, reforming the vision of the body and in turn reforming the processes with which we make sense of that vision.

3.4.3. CRISPR

A more contemporary form of cutting can be seen in use of clustered regularly interspaced short palindromic repeats (CRISPR). CRISPR is an immune system in

[75] These characteristics were decided on by Jack McKay Fletcher, comfort was a preference in the algorithm for the drone to avoid bumping into objects, balance was for the drone to retain equilibrium between objects and curiosity was for the drone to advance towards objects.

bacteria (Cossart, 2018) but has more recently been known for its use as a technology for genome editing. CRISPR allows cells to recognise predators (bacteriophages) and destroy them. Bacteriophages are viruses that attack by inserting their DNA into bacteria which corrupts the bacteria's regular mechanisms (Cossart, 2018). In a bacterium CRISPR is transcribed into RNA and then separated into small RNA strands. When the DNA from a bacteriophage enters the cell it binds to the strands, then an enzyme recognises it and "cleaves" the bacteriophage (ibid.). The strand is cut to remove it.

The cutting involved in regular CRISPR function is one that was found through scientific investigation, but this cutting has shifted from being a science to being a technology. The main discovery is that this cutting could be manipulated through the use of Cas9. Cas9 is a CRISPR associated protein which can work with a guide RNA strand to be used as a knife. This knife can cut the DNA and insert or remove things, meaning that the expression of the bacteria can be controlled. To understand this process many metaphors of cutting have been used to represent the idea of the separation of the DNA strand. Particularly in diagrammatical representations which often incorporates the symbol of a pair of scissors. The cutting of CRISPR has a different intent to the kind of cutting involved in Vesalius' anatomy, it is technologically engaged.

3.5. The bio-tech-body

The bio-tech-body is a model of the body that, like the anatomical body, is made of distinct parts. Although for the bio-tech-body those parts are not a datum, they are manipulable and useable. The anatomical body and the bio-tech-body are body models that have differing values. The anatomical body is predominantly for scientific knowledge; "science seeks to expand knowledge through the investigation and comprehension of reality" (Edwin and Layton, 1974 p.40). The bio-tech-body is technological and "seeks to use knowledge to create a physical and organisational reality according to human design" (ibid.). Technological knowledge is praxiological; concerning the use of knowledge to do things (Herschbach, 1995). This is a model of the body for which its parts are modular and accessible as material to do things with, or *design*. Similarly in the comparative description by Alexander (1964, p.130) "scientists

try to identify the components of existing structures, designers try to shape the components of new structures."

The contemporary cutting seen in the DTI scan of *Drones with Desires* and CRISPR lead to a capitalised model of the body through biotechnology. Where materials of biology are modified or made into products or applications. This is not necessarily a new enterprise, biotechnology has roots in farming and medicine extending far back in history. The contemporary cutting reveals that biotechnology now has an industrialised stake in scientific research. Which is concerning when the body is considered a manufacturing material vulnerable to corporate use. "The values of technology will relate to active and purposive adaptation of means to some human end, that is, it will relate to design" (Edwin and Layton, 1974, p.37).

The anatomical body is a datum, it is an authoritative, static and enduring model used as a means to control how the body is dealt with, the bio-tech-body on the other hand is a (i) provisional, (ii) intangible and (iii) speculative model which, due to its technological nature instigates change in the name of human design. Below is an outline of these three characteristics of the bio-tech-body.

(i) The bio-tech-body is provisional.

The instruments of knowing the body have created snapshots of it, static in the ink of *Fabrica* and ever still in Ruysch's suspended preservations. From enhancing the hand with the tools of cutting and the eye with imaging, means that seeing at the micro or nano level reveals active bacteria and even in decay shows a vibrant mass of activity. The body is indeed a "coordinated crowd" (Mol, 2002, v.iii), it is shifting, squirming, vibrating, multiplying, generating materials can now be observed using contemporary cutting techniques in "living anatomy" (McLachlan, 2004)[76]. Through use of tools it is clear that in the finest cuts the body is not static. It is fleeting; it moves, changes, decays and grows as images are taken.

(ii) The bio-tech-body is intangible.

The images of Vesalius (1543) were created to democratise the materials of the body, the flays of the body were made to be as accessible as pages of a book, but they

[76] Living anatomy refers to the use of real living human bodies or patients in study, often enhanced by projection onto their skin, interaction or exemplary actions.

were also defined in the print. The bio-tech-body has become digitalised in tools like Anatomage (n.d.), BioDigital Human (n.d.), Visible Body (n.d.) or eHuman (n.d.)[77]. These digital cadavers are immortalised bodies with the benefit of zoom and reset functions. The digitalisation of the body in these tools and resources such as Visible Human Project (VHP)[78] show "impossible anatomies" (Thacker, 2001)."The impossible is that which highlights the point beyond which a body loses comprehension, beyond which the body is laid bare, constituted by boundaries which are also in excess of it" (Thacker, 2001). It exists beyond the body in the ether of datasets and algorithms, losing the physical presence, smell and tactility of its viscera[79].

(iii) The bio-tech-body is speculative.

The datum of the body is concrete and intended to represent the truth of the body as it is. The bio-tech-body, on the other hand, is somewhat volatile and unknown. Experimentation for technological purpose may result in future outcomes that are not yet fully conceivable. The recent revolution in epigenetics for example, contends the "perceived mechanistic determinism and loss of free will" (Punt, 2017) usually prevalent in the code of life, the human genome. Epigenetics suggests that people are not "hard-wired" (Bird, 2007, p.396) and environmental influencers can play a part in gene expression. Although some remain sceptical, waiting "until these sorts of hard data arrive" (Buchen, 2010) not wanting to make "hard" statements using "soft" judgements (Funtowicz and Ravetz, 2003). The consequences that one may have the ability to alter their progeny based on quotidian decisions such as what to eat for breakfast or even on the contents of thoughts has been attributed to "opportunist quacks" (Gorski, 2013). Yet in the infancy of this concept there has been flourishing speculations on what this might mean in the understanding of the design and control of the complex and messy human body (as above).

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[77] Often linked to MEDLINE an offshoot of PubMed and will send citations and abstracts of papers linked to the body parts or pathologies on the digital cadaver for pedagogical purposes.

[78] The Visible Human Project (The National Library of Medicines Visible Human Project, n.d.) was a project by the U.S. National Library of Medicine, in which a cadaver of a male and female were extensively scanned and the data was used to create 3D cadavers. The data is accessible for public use and has been used for many different applications such as education or artwork.

[79] In a meeting with Vrolijk museum director Laurens de Rooy informed me that the issue with the specimens were that they lost the smell which was so important to the diagnosis of disease. The wet specimen collection according to him loses this important nuance of the body.

> Perhaps it is some surprise that in epigenetics—at the core of contemporary biology and neuroscience—we have the strongest case for arguing that any division between science and culture is both unsupportable and foolhardy. (Punt, 2017)

As epigenetics has opened up the possibilities for the body to be imagined as a dynamic site of change, the methods to deal with this model too must incorporate dynamic speculation.

3.6. A return to the complex and messy

The current zeitgeist of the bio-tech-body exhibits the above three characteristics in a way that has once again brought the body and design in intimate dialogue with one another. As Punt reiterates, science and culture should not be divided. This is brought into focus by the insights gained in epigenetic research. Returning to Kuhn (1970), this may be the initiation of another revolution resulting in the rules and structures of a fresh paradigm.

> The traditional 'normal' scientific mind-set fosters expectations of regularity, simplicity and certainty in the phenomena and in our interventions. But these can inhibit the growth of our understanding of the new problems. (Funtowicz and Ravetz, 2003)

In the case of the provisional, intangible and speculative bio-tech-body "facts are uncertain, values in dispute, stakes high and decisions urgent" (ibid.). Funtowicz and Ravetz (2003) therefore propose "post-normal science," a novel approach which incorporates uncertainty and ambiguity in order to add a critical element to science which is inclusive of its complexities. An approach which might be more suited to dealing with the bio-tech-body. As the proclivity of this model of the body is to make the human body vulnerable to change, any decisions encircling it have high stakes as there is risk in impacting the health and well being of the body.

There is even movement toward the provisional, intangible and speculative in what Funtowicz and Ravetz (2003) call high stakes issue-driven sciences such as health. Sabine Wildervuur (2017) considers a call at an international conference to redefine health, comparing the definition of Health from the World health Organisation (WHO) to be a static view of the body. For WHO health is a "state of complete physical and mental wellbeing and not only the absence of disease" (World Health Organization, 2006). In comparison to the proposition of health by Huber et al. (2011) which considers the body as dynamic. "Health as the ability to adapt and to self manage, in the

face of social, physical and emotional challenges" (Huber et al., 2011). Wildevuur positions this proposed second definition of health as an ethos for the Design for Health journal (Wildervuur, 2017). Her curation work on exhibiton *De Gezonde Mens* (2013) (aka *Designing Health*) showed the past, present and future of the impact design on health. This exhibition made clear that many of the contemporary designer's work on show engaged with Huber's more dynamic definition of health, particularly those gazing into the future.

The allure of this body for designers is that its provisional, intangible and speculative nature make it once again complex and messy. An attractive challenge for designers to "impose meaningful order" upon (Papanek, 1984, p.4), particularly when its technicity enables space for design to intervene. Many of the contemporary works in *De Gezonde Mens* enacted the bio-tech-body in relation to quotidian life. This may again be due to the technological rather than scientific persuasion of this model. "[T]echnological knowledge cannot be easily categorised and codified as in the case of scientific knowledge" (Herschbach, 1995, p.33) because knowledge of technology is engrained in normative activity rather than expression of activity as it is played out in science. Enacting the bio-tech-body allows designers to explore the stakes regarding health more immediately. Enacting the stakes associated with the bio-tech-body through the making of artefacts means the soft judgements mentioned by Funtowicz and Ravetz (2003) may be somewhat stiffened without the lengthy navigation of ethical approval to make hard statements of science. Especially when ethics have yet to be decided on in the case of some of these nascent biomedical and healthcare technologies.

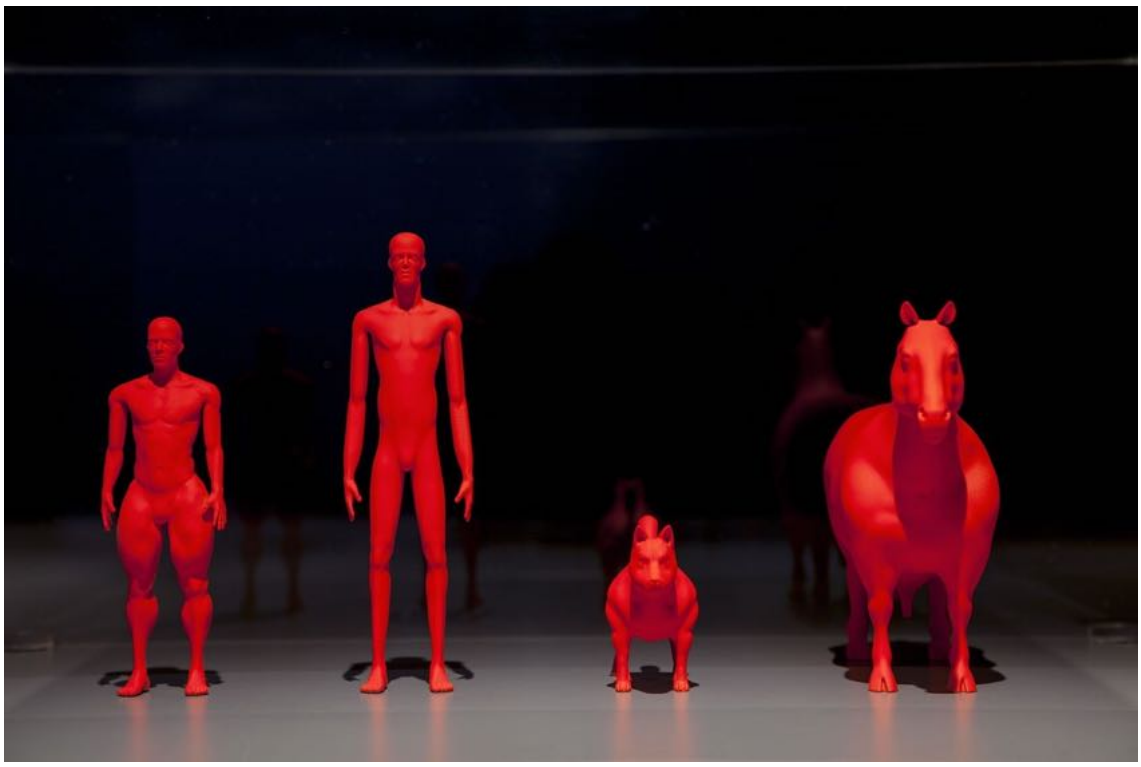

fig.17: **Cyclist, Balloonist, Pitsky and Hox. Dunne and Raby (2012/2013)** ***United Micro Kingdoms*** **[mixed media] Design Museum, London. Photographed by Jason Evans.**

The provisional, intangible and speculative elements allow opportunity for designers to be involved not in the design of the human body directly, but in the model making of the bio-tech-body. In Dunne and Raby's *United Micro Kingdoms* (Dunne and Raby, 2012/2013) the design of the cyclist and balloonist's strangely shaped bodies are not proposals for how the body should be, rather they "interrogate the cultural and ethical impact of exciting and new technologies and how they alter the way we live" (ibid.). Dunne and Raby imagine a fictional future in which England is divided into four countries, one of which the "Anarcho-evolutionists…concentrate on using science to maximise their own physical capabilities" (ibid.). Similarly, Nestor Pestana's project *The Infumis* (Pestana, 2015) considers a scenario in which humans synthesise pollutants through bioengineered hair, in a film showing an actor soaking in a bath whilst absorbing the smoke from a cigarette. The project again is not necessarily supporting an argument for this biotechnological modification, instead Pestana writes it is "a critique of a society increasingly 'addicted' to toxicity" (ibid.). This kind of work is differentiated from those such as Stelarc (Stelarc, n.d.), Orlan (artnet, n.d.) or Neil Harbisson (cyborgarts.com, 2020) for example, who directly edit their own bodies in

support of a transhuman or cyborg agenda. These artists, often considered under the umbrella of bioarts, aim to make an intervention into the human body first and the model of such second. Using their own bodies as an example to then alter the model of the body. Stelarc's performances are often feats of endurance highlighting the propensity of the body's survival alongside technology (Baraibar, 1999). On the other hand, the projects of Dunne and Raby and Pestana mentioned above aim to make an intervention into the model of the human body first and the human body second. The work considers how the body might change over time, often incorporating technologies which are not fully in existence. This is a means to interrogate how models of the body that incorporate these technologies might affect how we consider the body now. Envisioning a time beyond the bio-tech-body or one in which it may have become the norm, the post bio-tech-body.

3.6.1. Conclusion

This chapter shows that through the eyes of a designer the process of creating, establishing and advancing the anatomical models of the body share similarities with a design process, with the production of a structured model of the body as a design outcome. This model has gone through an iterative design process as it has developed through the design of different imaging techniques and tools in an attempt to understand it more fully. Through this process it has reached another significant redesign referred to in this thesis as a paradigm shift. Design, although always clearly integrated in the endeavour to know the body, is re-introduced into the dialogue with a different relation than before as this shift occurs.

The premise of the argument in this chapter is based around the large claim within critical theory that the body is an open text subject to intentions, instruments and technologies known to describe it (Dijck, 2016; Hodder, 2012). The more we try and know the body, the more complex it becomes as new techniques for knowing the body slice the cake of the body further, therefore making its surface area more complex (Drayson, 2011). What these paradigm shifts in this chapter show is that anatomy has been historically set up so images are proof of the body, yet the body is consistently changing which calls for a reevaluation of means of imaging and communicating it. Since the enlightenment the body has become increasingly "technically aligned" (Thacker, 2001) and in doing so its propensity for change is being more

frequently included in its imaging. The images of research to suggest new models become imaginative spaces in which dynamic changes are representational (such as in the artificial neural networks that use algorithms to show neural motion) or projected onto (like images representing CRISPR which show the action of cutting to imagine the removal or addition of materials).

The purpose of this review of major design choices in making body models that have led to the bio-tech-body is to reveal that designs for and of the body are not in fact the human body, as Johnson (2008) would describe it above, but are models of the body. What the models have shown us is that the body does not necessarily have to be there for people to talk about it and engage with it, its imaging can dictate the focus towards particular parts. As now it can no longer be assumed that the bio-tech-body has concrete edges and there are no longer necessarily fixed points of reference to measure or access the body from. Therefore design has to access the body in ways that is suitable to image its dynamism. The next chapter will show that design has followed a similar trajectory to anatomy which means they now converge in ways that allow designers to engage with the body through not necessarily working with its materials but working with its models. This allows a projection of the body across alternative times and places. As designers become increasingly involved in describing the bio-tech-body they shape it. The model of the body is no longer just a reference to to be designed as such, but now it is a material for design to explore. As the disciplines associated with the bio-tech-body begin to include increasingly provisional, intangible and speculative characteristics, the body moves beyond the datum of the traditional atlas, towards an open text, one on which many stories can be written.

4. DESIGN

4.1. Shifting Forms of Design

In this chapter I will compare anatomy and design as mobile discourses, showing a correlation between the paradigm shifts that occurred in anatomy and how they can be mapped onto design. Like the study of the body through anatomisation, by studying design it is also anatomised and deconstructed into parts. While this deconstruction has been fruitful in many ways, it is also responsible for "focusing attention upon a small range of relatively esoteric problems" (Kuhn,1970, p.24) in a similar way to the anatomisation of the body. The delineations of design have been anatomised through a somewhat scientific approach by observing its methods. The conceiving of a universal method being known as a form of "design science" (Cross, 1993, p.20), and the studying of the nature of design being known as the "science of design" (Cross, 1993, p.21). This chapter, in a similar fashion to Chapter 3 (Body), will look at why design is anatomised, what the datums of design are and the paradigms shifts of design. Following a trajectory of design anatomisation that leads to a provisional, intangible and speculative model of design. These three characteristics, which are perhaps not new appendages, instead create a form of design that is adjunctive to the organs of design.

This chapter shows that there are both benefits and draw backs to anatomisation. Concluding that rigid terms help in collaboration but intra-disciplinarily loose terms are more advantageous. This is to retain nuance of terms without pre-emptively cutting and potentially losing valuable aspects that these terms may offer. This chapter will begin by describing how design has been anatomised through defining and naming its parts, similar to anatomisation of the body seen mirrored in the last chapter. No further anatomical structures (or terms for forms of design) will be added to this body of design research, as mentioned in the caveat in the introduction. This is not in disregard to the etymological conundrum of speculative design, but instead to draw attention to the characteristics of this type of design work which may exist beyond these

locutions as they are currently understood, in the hope to advance them. Those being the values seen in the types of design named in the locution section in the introduction. This will show that these forms of design may not necessarily be separated organs but may be an adjunct to larger organs of design and beyond. Traits of these adjunct specialisms, that are currently under the microscope, might position design as a relevant method for engaging with the body. This is mainly due to this model of design sharing characteristics with the bio-tech-body, as well as it being a hybrid adjunct that exists at the fringes of design practice.

The body is not unfamiliar territory for design, as learnt in Chapter 3 (Body), design has used the body as a stable reference point, but the body is now provisional, intangible and speculative. Design therefore must also transform to accommodate for the changing form of the body. Elements of speculative design may lend themselves to facilitating this transition such as its concern with *trajectories* and *opening up*. Characteristics found in speculative design events such as *overspilling* and *trickery* between the boundaries of the mundane and exotic (Michael, 2003) are outlined below. These characteristics show that design could be considered a bridging practice (Malpass, 2012) or exchange between the insights that arise in research related to art and design and paradigm shifts in approaches to the body.

It seems reasonable to say, from my position as a practitioner who associates their work with speculative design reflecting on it, that even though its definition is still somewhat ambiguous, speculative design is not just terminological fodder for design-research. The anatomisation of design has shown that the projects, discussions and arguments orbiting the topic of speculative design has brought to light aspects of design important to designers, and that are in need of consideration. The takeaway being that design, in these formats may be a helpful investigative instrument that is linked to changing body knowledge. This is shown through examples which highlight how the relative mobility of thinking in speculative design can intervene in cutting edge research in biotechnology.

This will prepare the ground for the next chapter which explores selected tactics for designers to engage in this dialogue. In Chapter 5 (Body - Design), four tactics are outlined with terms borrowed from other disciplines. This is in order to further designer’s ownership of tactics and their terminology which might be shared or

come from other disciplinary camps, building up the "defensive network of related theories, ideas and knowledge" of Cross' (1982, p.31) *Designerly Ways of Knowing*[80]. This is in the hope of aiding a more nuanced steering of these tactics and terms already in use and that are orbiting speculative design or have been used to describe speculative design projects. Particularly in relation to the practice found in the annex: Portfolio of this thesis. The terms describe particular tactics which may be helpful for ideas exchange but have not yet been cemented firmly in the design discipline. Designer's work will be highlighted that is already intimately engaging in research regarding those terms to pull them more meaningfully towards design concerns.

4.1.1. The Anatomy of Design

It is made clear in the previous section, Chapter 3 (Body), that the body has been deconstructed, segmented and systematised through the study of anatomy. An 'anatomy of' something is a descriptive procedure. Considered to be the method of deconstructing a topic or object in order to understand its working processes. Then presenting this knowledge as a different construction or vision of the original reorganised so as to describe or interact with the original. Referred to in this thesis as a mental model. Like the body, design is a discourse that is split and segmented into parts; it is a discourse that has also been anatomised[81]. These parts all fall under the larger umbrella of *design* and usually include a description often in the form of a prefix or suffix that segments design into a specialism. For example: graphic, ludic, fiction, industrial, product, engineering, social, futures, motion, systems, critical, user experience, bio, speculative, interior, fashion, web - to name a few. Although there are endless crossovers and exchanges between the different design specialisms, the titles are there to help talk about particular intentions or flavours of design. These titles may seem arbitrary for some, for example Tonkinwise (2015) argues, "every time you qualify design with, or add design to, some other quality or practice you are claiming that design does not already do that." There is merit in the argument that within design

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[80] Cross (2004, p.14) warns of "importing models of behaviour from other fields." This is not to import behaviour but to gain control of the terms already in use.

[81] Consider Foucault's proposal in Chapter 3 (Body) that pathological differentiation has impacted institutional frameworks such as the delineation of hospital wards. In design the delineation could be what defines departments at a university. Further informed by Fuller (1968, p.3) "All universities have been progressively organized for ever finer specialization."

practice are many varying methods and these methods are shared and explored across the specialisms regardless of title. Yet in learning from Chapter 3 (Body) there are benefits to segmenting or making an anatomy of something as a way to describe or generate a language to discuss how to deal with its materials. Particularly to those external to the discipline or specialism.

The reason for using the knife of design study to anatomise design is analogous to creating the model of the anatomical body. Like the difference between the body and the constructed model of the anatomical body discussed in the last chapter, design and the constructed model of design are two completely separate entities. Design seen through the eyes of those studying it creates systematised visions of design, whereas in design practice there is of course no strict design methodology or boundaries; design seems to come in as many forms as there are designers themselves, just as bodies do. For Auger (2013) the semantics of terminology has less impact on the practising designer who intuitively interacts with the artefacts and their making on an everyday level. Auger posits that the terminology is more important for those "unfamiliar with these practices" using the terminology as a way to "affect how the work is experienced or assessed" (Auger, 2013, p.12). Therefore intra-disciplinarily to design, anatomisation with less rigid and new vulnerable terms may offer useful concepts that can contribute to the understanding of the model of design as a whole.

As mentioned in Chapter 3 (Body), just because the anatomised version is a construct this does not mean this vision is not valuable or useful. The anatomised model can help formulate ways to *open up* topics, but can also create problems in the object of study's conception separated from the model. The anatomised model of design shares these benefits and doubts. The segmentations can be a constructive way to talk about design, a subject that definitely deserves its own designerly language (Cross, 1982) and attention in order to better understand its processes. In not offering or attempting to construct an anatomised vision of design, the insights which have been so advantageous from the anatomised view of the body in generating knowledge for health and well being, may be lost for the design discipline. Although, as learnt from anatomical study, anatomisation has also been the route of formulating static models with boundaries that are difficult to shift.

The titles, as Tonkinwise suggests, may just be a proliferation of "the artificial ecosystems of academic design research" (Tonkinwise, 2015), and of course there is an apparent sense of irony in discussing this directly in the format at which Tonkinwise declares his "despair." Especially in a landscape of design research in which Nigel Cross (Cross, 1993) argues there is little historical rigor. New terminology in this case may easily be proposed and contested without extensive support. Yet contrastingly without anatomisation, minutiae may be lost without the finer or contemporary forms of cuts, similarly to the increasingly anatomised body in the previous chapter. For example, in the case of anatomising the body; the appendix, is an organ whose construct has changed over time. A sudden advance in anatomical study supported the argument against the impression that the appendix was simply a vestigial organ (Smith et al., 2009). An organ which only until recently was considered ineffective, now has a function that has been bestowed upon it. This new concept of the appendix may be useful in understanding the health and well being of the gut. The organs of design may also alter in construct over time, in deconstructing, segmenting and systematising them new understandings are developed of the flowing exchange of different processes throughout the gestalt entity of design.

4.1.1.1. How to cut design

> First, the taking in of scattered particulars under one idea, so that everyone understands what is being talked about… Second, the separation of the idea into parts, by dividing it at the joints, as nature directs, not breaking any limb in half as a bad carver might. (Alexander, 1964, preface)

This excerpt from Phaedrus in which Plato writes about how to structure an argument is the epigraph for Christopher Alexander's 1964 book *Notes on the Synthesis of Form* (Alexander, 1964). Alexander uses this to describe how and why breaking down and segmenting can help the cognitive load of dealing with complex topics and problems for designers.

The first part of the Plato quote is used by Alexander to describe the increasing complexity of problems that are difficult to grasp intuitively by designers. His description of this increasing complexity parallels the increasingly fine cuts of anatomy, as more cuts are made the body becomes more complex. As seen in Chapter 3 (Body) with the development of the knife and the domino effect of the trajectory of cutting technologies and the body. Alexander makes a similar claim in regard to the increasing

complexity of design problems “reaching insoluble levels of complexity” (Alexander 1964, p.3) and no longer comprehensible intuitively by one designer alone. As design is more finely interrogated, there is more to be found in the minutiae. The model of design is reshaped, and new knowledge is acquired. As design terms are founded, they are then segmented to find new structures and then those are divided to find new structures and so on and so on; until design, like the body, seems to become a subject of infinite divisibility. Alexander describes how problems become more complex as further information is found, specialist experience is consulted, new materials are developed and there are changes in social patterns and cultural shifts.

The second part of the quote regarding separation and division is used by Alexander to describe ways designers have used segmenting and breaking down as an approach to deal with complex problems. This is so that the aggregate problem solving may help benefit a larger problem. Breaking into specialisms or parts which can be overcome or “divide and conquer” as Buckminster Fuller (1968, p.8) describes. These ideas often used in analysis (Buchanan, 1992), are also relevant here to understand the anatomising of highly complex topics of interest, such as the body or design. The carver, like the anatomist would not break any limb in half, as in the previous Chapter 3 (Body) this is the area that the knife and material of the body most efficiently affords, “as nature directs.” The breaks in the body of design are in areas where there are softer lines drawn or in areas of less attention. Like the appendix, areas may be reconstructed and new functions may be brought to light, regardless of if they were functions of the appendix all along. Speculation (the subject of interrogation in Tonkinwise’s paper, 2015) has been an aspect of design all along, but bringing this aspect of design into focus may reshape the understanding of design and how this function can be used in different ways.

Firstly, this chapter will consider how design is currently being designed through anatomisation. According to Tharp and Tharp (2018) there are different ways to “impose meaningful order” (Papanek, 1984, p.4). In the study of design analysis is where “complex things are reduced into simpler parts” (Tharp and Tharp, 2018) and classification is “a means of grouping or sorting things and arranging them systematically on the basis of shared qualities” (ibid.). From Tonkinwise’s argument it seems finding knowledge in design is more a means of classification in which the parts

were there to begin with, they are just being organised[82]. The description of the anatomisation of design is to reveal how models of design are made and if this is a helpful resource for design.

The next move in this discussion is to show that as ideas move from being conceived as tame to being considered wicked (Rittel, 1972), they become too much for designers to deal with alone. “The intuitive resolution of contemporary design problems simply lies beyond a single individual’s integrative grasp” (Alexander, 1964, p.5). In which case speculative design may be considered a part of design which can not necessarily solve these problems alone, but can engage with these complicated problems using new methods to communicate design ideas. Similarly to the model of the bio-tech-body, this leads to a provisional, intangible and speculative model of design.

As design is anatomised into the minutiae, it too becomes a wicked problem. For a vastly wide group of designers and design networks, to collaborate on the endeavour of defining aspects of design into a definitive consensus is nearly impossible. It starts to become clear that the interest in the anatomisation of design is due to many involved in the design discipline feeling the allure of designing the “insoluble levels of complexity” (Alexander, 1964, p.3) of the complex topic of design by attempting to “imposing meaningful order” (Papanek 1984, p.4). As Buchanan (1992) writes, the drive to find a consensus on defining aspects of design is not the duty of the common beliefs, methods, philosophies, or design objects to adequately imply a definition. Instead, those who engage in this challenge are those that “share interest in a common theme: the conception and planning of the artificial” (Buchanan, 1992, p.14). Many want to play the role of Vesalius in finding models of design. This reveals a particular challenge to speculative designers and those associated with provisionality, intangibility and speculation, whose association with the artificial is even more potent.

There are a number of ways that the knife of design study can cut the cake of design[83]. This thesis is concerned with epistemological and praxiological design study

[82] In some cases he believes the classification its unwarranted.

[83] Analogous to Drayson’s description of cutting the cake of the body, in the previous chapter (2011)

(Cross, 1982)[84], or how design generates ideas and knowledge through design practices. This is less a study of object output and form. Although this chapter somewhat mirrors the epistemological and praxiological study of anatomy, the anatomisation of the body and the anatomisation of design is comparable asymmetrically. As the cutting of design is still in its infancy (DiSalvo, 2012)[85] in comparison to the cutting of the body. The direction of cuts is still contested and an anatomised model of design is what Christopher Frayling (1993) may imagine some might describe as looking at design from "arms length." Frayling writes of the role of research in the venture to anatomise. He talks of a shift in art and design research, from the conception of research as "going over old territory" to "what artists, craftspeople and designers do all the time anyway" (ibid.). Frayling proposes three forms of researching art and design,

+ Research into (art and)[86] design

+ Research through (art and) design (RtD)

+ Research for (art and) design

Research into art and design is described by Frayling as the study of the theory or history of art and design. Research through art and design is what some may call applied research in which a goal is set and material research and development may build towards the goal of furthering, altering, improving or expanding on something. Research for art and design is what Frayling (1993) describes as thinking being embodied in an artefact and it communicates this knowledge not verbally, but through a "sense of visual or iconic or imagistic communication." The issue of using the knife of anatomisation is that it implies these terms are mutually exclusive. Zimmerman (2003) equates design itself to research, as it is a way to create new knowledge. The processes of prototyping makes this abundantly clear; knowledge is created through the iterative making and reflecting. Prototypes can make otherwise unexperienced interactions become experienceable or may bring discussion to the surface which otherwise may

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[84] In *Designerly Ways of Knowing* (1982) Cross discusses three forms of design research, epistlemology, phenomenology and praxiology.

[85] "As professions go, design is relatively young. But the practice of design predates professions" (DiSalvo, 2012, p.ix).

[86] The brackets here are to show that I am mainly talking about design in this context but Frayling wrote about the similarities between the two, this was a core of his essay. This is not to dismiss the art side of this discussion but just to extrapolate the aspects which relate to design specifically. This is often done in design research in reference to RtD (Bardzel et al. 2015)

have not been there, these come into existence through the design (Stappers and Giaccardi, 2015).

In speculative design, final outcomes may be mistaken for products or artefacts as they appear to have a sense of finality. Bardzell (2015) sees these artefacts as knowledge producers, this may share a resemblance to research for art and design, as ideas may be exchanged through the objects themselves, although the objects of speculative design are in many cases not resolved. Speculative design in this sense shares processes most predominantly with RtD because the outcomes are still ongoing, they are prototypes that rehearse or test ideas. As seen in the previous chapter the body is increasingly perceived as dynamic; the model of the bio-tech-body becomes an ongoing prototype which research can be done through.

4.1.1.2. What has anatomised design taught us?

"No single definition of design, or branches of professionalized practice… adequately covers the diversity of ideas and methods gathered together under the label" (Buchanan, 1992, p.5). Buchanan (1992) describes the shift of the liberal arts from "a patchwork quilt of specialisations" towards a "modality of impossibility" (ibid. p.6). The separation of design has been beneficial in creating specialised focus for those beneath one terminological umbrella, as with the body. Being clearly beneficial for pedagogical means, making information comprehensible and easy to understand and perform in a similar way to anatomy. But, like anatomisation of the body, the model does not describe the extent of the whole.

Mirroring Frayling's parlance, the design for (art and) design seen in RtD might be a way of using practice to unearth complexities which otherwise do not fit "under the label" (Buchanan, 1992, p.5). This type of design is not limited to, but most clearly can be seen happening within the doors of a university; in which researchers and students explore the boundaries of design through doing it and through researching it simultaneously. In this context it is as Frayling describes 'research'. Beyond the academic world this design for the sake and research of design is less prevalent and often considered frivolous. This causes the speculations to be criticised as being dystopian futures which are actually lived experiences of a concrete present (Ansari, 2015). Which has raised questions regarding design being driven by solutionism.

4.2. Static to Dynamic Design methods

4.2.1. A move away from orthodox design methodologies

In Buchanan's (1992) description of the paradigms of design methods, he writes that design was once predominantly split into two phases:

i) Problem definition: "an analytic sequence in which the designer determines all of the elements of the problem and specifies all of the requirements that a successful design solution must have."

ii) Problem solution: "a synthetic sequence in which the various requirements are combined and balanced against each other, yielding a final plan to be carried into production." (Buchanan, 1992, p.15).

Buchanan suggests that design, in this two stage form, happens linearly and in easily segmental parts resulting in determinate solutions that are concrete. "When people think of design, most people believe it is about problem solving" (Dunne and Raby, 2013, p.2) in that designers come up with solutions that are resolute. This may be due to the idea that "the origins of design methods lay in scientific methods" (Cross, 1993, p.19). A drive to find the overarching formula for design was influenced by the birth of specialisms that overlap with science, in particular engineering and materials science, according to Cross (1993). These methodologies lay the ground work for the model of design being one that is a systematic solution driven activity.

"Expert designers appear to be 'ill-behaved' problem solvers, especially in terms of the time and attention they spend on defining the problem" (Cross, 2004). Cross argues that design experts are predominantly solution focused and frame their own interpretations of problems to direct them toward a solution. He warns of "importing models of behaviour from other fields" (Cross, 2004, p.14) and tries to build on design expertise by trusting the "intrinsic nature of design."

> If you are in a shipwreck and all the boats are gone, a piano top buoyant enough to keep you afloat that comes along makes a fortuitous life preserver. But this is not to say that the best way to design a life preserver is in the form of a piano top. I think that we are clinging to a great many piano tops in accepting yesterday's fortuitous contrivings as constituting the only means for solving a given problem. (Fuller, 1968, p.2)

Fuller describes that society has perceived specialisations as the key to success. Yet it also "precludes comprehensive thinking" (Fuller, 1968). Fuller suggests looking at the

whole, as a child might. According to Schön (1983) "professional practice has at least as much to do with finding the problem as with solving the problem found." Schön posits that there is complexity in finding problems, which is often ignored as part of the design process. "[C]omplexity, instability, and uncertainty are not removed or resolved" (Schön, 1983) in professional circumstances they are just harder to describe and are therefore frequently left from the model. As learnt from Chapter 3 (Body) leaving things from the body model can mean that the body itself is not treated inclusively of those parts.

> In real-world practice, problems do not present themselves to the practitioner as givens. They must be constructed from the materials of problematic situations which are puzzling, troubling, and uncertain. In order to convert a problematic situation to a problem, a practitioner must do a certain kind of work. He must make sense of an uncertain situation that initially makes no sense. (Schön, 1992, p.3)

The designer therefore is burdened by decision making when models are formed. The image of the designer Papanek builds in *Design for the Real World* (1984) is one who has a moral code, with a responsibility for the impact of their decisions. Papanek suggests that the importance of significant change is in the hands of the designer and that the bad habits of consumerism may be impacted positively by the transformation of design. This is also the premise of the argument in *Designs for the Pluriverse* (Escobar, 2018).

This moral drive for design can perhaps explain the significance of the design manifesto, a set of values or ethos that outlines or justifies design decisions. Two of the most famous being *Ornament and Crime* by Adolf Loos (1975) who argued that the designer should prevent ornamentation as a way to design more efficiently for longevity rather than for an ongoing design to suit the fashions of change. Another is *The First Things First* (Garland, 1964) a graphic design manifesto which calls for a "reversal of priorities in favour of the more useful and more lasting forms of communication." A push by designers against consumerist design that promotes longer-term visions, fights against "gimmicks and wastefulness" (Dunne and Raby, 2013). Papanek's vision is shared across the manifestos[87], designers are making a case for projections that are beneficial for the future, or that exist along a longer timeline, preventing the careless

[87] Papanek opens his book with a pointed commentary on this "There are professions more harmful than industrial design, but only a few." A drastic critique on design for the time it was written (1984).

production of things. Dunne and Raby (2009) in their (a) (b) manifesto propose shifting models of design from concepts within column (a) towards those in column (b), to move away from methodologies that have been perpetuating destructive consumerist values, and instigate change in design.

> Faced with huge challenges…designers feel an overpowering urge to work together to fix them, as though they can be broken down, quantified and solved. Design's inherent optimism leaves no alternative but it is becoming clear that many of the challenges we face today are unfixable and that the only way to overcome them is by changing our values, beliefs, attitudes, and behavior. Although essential most of the time, design's inbuilt optimism can greatly complicate things, first, as a form of denial that the problems we face are more serious than they appear, and second, by channeling energy and resources into fiddling with the world out there rather than the ideas and attitudes inside our heads that shape the world out there. (Dunne and Raby, 2013, p.2)

They argue that changing the model of design as it currently stands in the collective minds of designers is what will create the shift from static visions of a problem solving discipline towards the dynamic vision of a problem finding one.

Rittel (1972) explains how means of solutions are already considered in trying to understand a problem, "with the first step of explaining the problem you already determine the nature of the solution." Blythe et al. (2016) suggest that solutionist work on technology can often be dismissed because "it solves problems that don't exist or ignores the complexity of personal, political and environmental issues." He proposes anti-solutionist strategies that seek to investigate problem spaces to "explore partial, problematic, flawed, and sometimes plain silly ideas" (Blythe et al., 2016, p.4971). He outlines the work of others in "un-useless objects" such as Chindogu, and "questionable concepts" with partial solutions (Vines et al, 2012). Blythe's overarching argument is to move away from "slick" design solutions (including those frequent in speculative design) in order to acknowledge complexities and make a case for the ongoing artefacts that should not represent resolution. Those that can be seen in RtD. This supports Christopher Jones' (1992) idea that design should move away from traditional methodologies which train designers to focus predominantly on the final outcome, towards a series of methods that promotes attention on the thoughts that precede the outcome.

Like the sciences, design has found comfort in not moving beyond scientistic styles of formulaic problem solving. As Ansari suggests (2015), work about futures can of course still be solution driven, as one might argue all design is future facing, although

speculative design does have a particularly strong flavour of "anti-solutionist strategies" (Blythe et al., 2016). Blythe et al., (2016) briefly mentions two forms of solutionism which are not necessarily distinct from one another. One reduces problems so that they more likely fit within the remit of solutions offered and the other is technological solutionism in which people are seduced by the idea of technologies capable of dealing with otherwise complex issues. Rittel (1972) might call the first form the traditional systems approach to dealing with "tame problems." In which he outlines eight steps of the process of solving tame problems:

i) Understand the problem

ii) Gather information

iii) Analyse the information

iv) Generate solutions

v) Assess the solutions

vi) Implement

vii) Test

viii) Modify (Rittel, 1972)

Rittel (1972) describes the paradoxes of rationality in the attempt to position some problems as tame. Instead he considers the challenge of wicked problems which mirror Alexander above in the increasing complexity of design problems. "[T]he traditional way of dealing with complexity is to operate, at any one time, only upon a single conception of the whole" (Jones, 1992), by reducing a wicked problem to a tame one integral nuance is lost.

Anatomising anti-solutionsim changes conceptions of design from traditional problem solving, which can be an uncomfortable addition to its model. "Nor do scientists normally invent new theories, and they are often intolerant of those invented by others" (Kuhn, 1970, p.24). Seen clearly in the arguments opposed to the paradigm shifts in relation to changing models of the body, design is also experiencing oppositions as it enters the anatomisation of new paradigms whilst terms are still fragile concepts.

Buchanan believes the shift in design may be expedited due to the change in technology, the second form of solutionism mentioned in Blythe et al,. (2016). The need for a broad theory of rhetoric in design was less urgent when technology seemed to be

under rational control and designers worked within a generally accepted view of the way design should function in a well-ordered society. But now, as technology becomes increasingly specialized and isolated from design practice and as designers have so many conflicting and confusing opinions about their own practice, the need has special urgency. To bring these problems together in a single, comprehensive theory is a difficult challenge, but one that explains better than any other the rise of design studies as a serious field of inquiry (Buchanan, 1985).

It could be the increasingly provisional, intangible and speculative model of the bio-tech-body that has wrenched design forcibly into another paradigm. As Thackara (1988) explains post-industrialised technologies have caused a movement in design's focus "beyond the object." Or perhaps it is movements in design that have changed the way the model of the body is dealt with. My inclination is that they both can inform the other, as argued in Punt's paper on epigenetics in Chapter 3 (Body). Regardless of the chicken and the egg situation, through following models of the body and models of design, it is revealed that shifts in the models of both are occurring in tandem. Anti-solutionism may be due to Buchanan's insight, that as technology becomes increasingly difficult to control it becomes separated from all aspects of design and therefore design has more of a view from a distance.

4.2.2. Speculative design as adjunct

This motion from static methods of design to more dynamic forms are seen spanning across the organs of design. Speculative design has predominantly been considered a specialism or design discipline; an organ in its own right. The subject of speculative design was first introduced at the Royal College of Art by designers Anthony Dunne and Fiona Raby as part of the ethos for the Design Interactions course, building on their concepts of critical design (Dunne, 2005). It has proliferated far beyond this, and has more proliferation to do (elaborated on further in Chapter 5 (Body - Design). Being its own course at a large institution is perhaps what has begun its anatomisation to situate it a specialism in its own taxonomic group, but its characteristics which lend themselves to more dynamic forms are seen among other specialisms. Take the influential Superstudio architecture project *New New York* (1969) in which new, radical buildings could be built above the skyscrapers. A project made to fly against their distaste for "intensifying consumerism their work supported" (Blythe et

al., 2016). Think also of Neri Oxman's speculative biological wearables for example *Mushtari* (2014), an external intestinal fashion item which could convert daylight into consumable sucrose. Also Ilona Gaynor's *Everything Ends in Chaos* (2011) reveals the designs involved in systems related to crime. A project that reverse engineers a global financial catastrophe. Frank Kolkman's designs for a speculative DIY open source surgical machine titled *Open Surgery* (2015). And Marguerite Humeau's resurrected sounds of a woolly mammoth in her work *Proposal for Resuscitating Prehistoric Creatures* (2012). These are to name a few examples of how speculation deals with a range of design organs. In regard to these projects, speculative design can span: architecture design, fashion design, systems design, engineering and sound design. This suggests that speculative design may not necessarily only be an organ which takes reference from these disciplines but it is a valuable adjunct to design in that it could act as a model which encourages the engagement with differing organs of design.

As design is often considered a discipline concerned with communication, the word adjunct is used from linguistics to denote what it is that speculative design does communicatively in relation to the other forms of design it may be connected to. An adjunct is often considered an addition to a sentence or phrase, in the above example from Superstudio they are still primarily designing architecture but situating these designs in context of geographical space and future time which suggests that these are not straight forward proposals. Adjuncts are not secondary in this case, they add contextual information. Adjuncts are usually adverbial in that they modify or qualify other verbs or adjectives through "expressing some relation of manner or quality, place, time, degree, number, cause, opposition, affirmation, or denial, and in English also serving to connect and to express comment on clause content" (Merriam-webster.com, 2020). In a sentence an adjunct often determines the circumstances in which action takes place[88]. When speculative design is adjunctive to other specialisms the focus is directed and value given to its adjunct elements. To return to Superstudio's *New New York* the focus is pulled towards why, when, and where the architecture takes place, rather than the structural elements of the design itself and in turn reflects a commentary upon the crux of the communication which is in light of architecture and city planning.

[88] Similarly in design an adjunct could determine circumstances which lead towards or away from a design.

Adjunct speculative design therefore may support intra-disciplinary collaboration, or collaborations and discussions within a singular discipline. As it may encourage focus to be pulled towards the relation between forms of design and their respective speculative elements or perhaps even other adjunctive elements. Like the anatomical body, the anatomisation of design that has led to this proposal has been through a heightened concentration of characteristics which show more concern with determining the circumstances in which designs take place; their adjunctive elements. These characteristics show that design, like the body is engaging more with the (i) provisional, (ii) intangible and (iii) speculative. Below is an outline of these characteristics with examples from the case study of *The Anatomy Lesson* to express them more coherently.

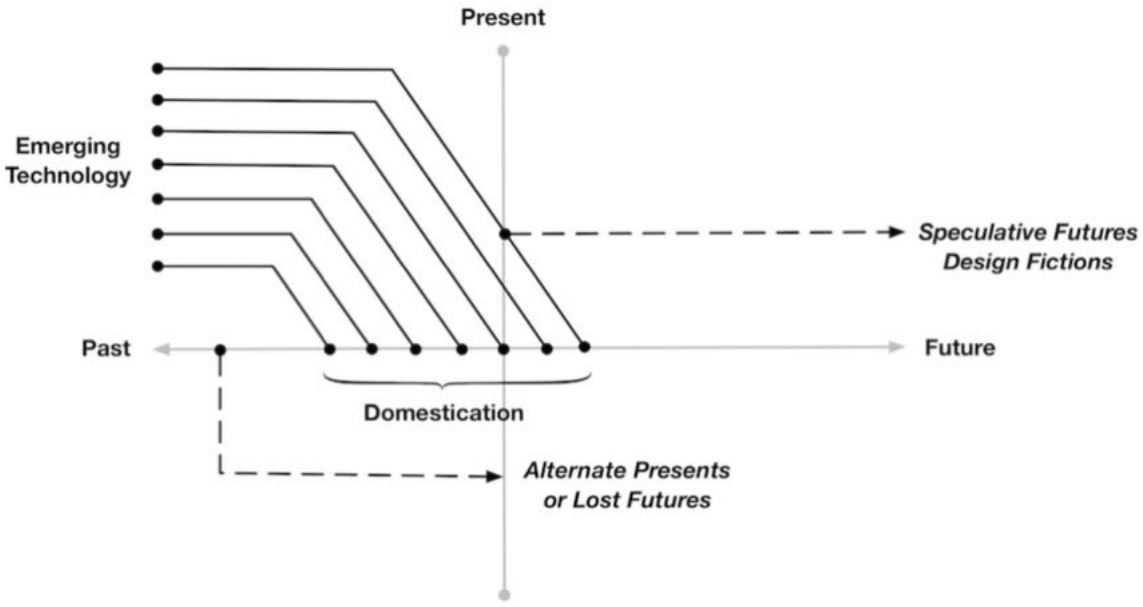

fig.18: **Auger (2013) Alternative Presents Graph**

(i) Design is provisional.

Design exists in a time frame that is shifting. The provisionality of this adjunct model could be a mechanism for dealing with *Future Shock* (Toffler, 1970). A way to manage fear and desires associated with a fast paced future that would otherwise be paralysing. Traditional design often deals with linear postalgia, or the ideals of "the good old days yet to come" (Land and Taylor, 2014). This comes from a capitalistic ideology that things and systems can be easily assimilated into the timeline of future

everyday life (*fig.18*). This design adjunct on the other hand deals with futures (multiple), creating multiple timelines, many of which we may not wish to align with (Smith et al., 2016).

The work may only have relevance for short periods of time, for example *The Anatomy Lesson* looked at procedures that dealt with futures that most probably would not align with the present for a long time (far futures) and futures that may be closer to the present and therefore more easily assimilated (near futures).

> If a speculative design proposal strays too far into the future to present clearly implausible concepts or describes a completely alien technological habitat, the audience will fail to relate to the proposal, resulting in a lack of engagement or connection. (Auger, 2012, p.138-140)

Since *The Anatomy Lesson* project has been made, further research has been conducted in regard to the technological focus of each sculpture cluster. Particularly on the bionic eye implant. Since the conception of the work, the aesthetics implants now being proposed have changed significantly. Which means that later iterations of the work have to accommodate this to retain the relevance of the piece. As further research into creating soft eye implants otherwise makes a significant part of my argument mute, it is uncertain if cysts may still develop if the materials are soft enough. This part of the work is no longer about the future, it is about the past, a past which never happened. The work is subjugated by the movement of time. Although I still plan to exhibit this work it is no longer in line with its original aims. Which was to consider the macro vision of the body and its response mechanisms to technological corruption of its parts, so to consider simulations for the medical practitioner of the future. As the contentions with bionic eye implants have been somewhat resolved this is no longer in line with this point so needs updating to suit the currently changing landscape of the model of the body due to this research. This work is therefore not a moment in a future that appears to be unfolding and instead looks at what would have happened if the technology was ethically approved or undertaken regardless in the present.

A different effect of provisionality on the generation of ideas can be seen in the *Alter-Terrestrial* project (annex: Portfolio). An attempt to consider the moral decision making regarding sending non-humans into space, in current times the work projects the consequences of change should they be forced to adapt to this anthropocentric agenda. Imaging a pig, cabbage and cup fungus subject to a forced morphological redesign as a

result of human decision making. The image of the future is a reflection of the present, using the sensibilities of the past. Although it is also in line with fashions of the moment, it is no coincidence that this work aligned with the 50th anniversary of the first moon landing, in which many exhibitions and events on this topic were opening. It is also therefore professionally advantageous to consider the provisionality of the current zeitgeist so that there is more chance to engage in networks when waves of technological desires and concerns are in vogue[89].

The future "could be approached as an open-ended possibility of the present, an ideology of liberation." (Gonzatto et al., 2013, p.36). Removed from the constraints of present time. The futures wheel "a form of brainstorming that identifies the consequences that could emerge from a significant change in the future" (Glenn and Gordon, 2009, p.2) in which primary and secondary consequences are mapped out to reveal a domino effect of consequences. Speculative design then gives these consequences flesh or form (Mazé, 2016) through building scenarios as a means of bringing these potential future moments provisionally into the present so that they may be considered in relation to current time.

(ii) Design is intangible.

The design work itself is a way of making things tangible, it is the idea that the work leaves behind and their context which have intangibility. Designs are increasingly not existing in the world as we know it, instead they exist in "fictional worlds" (Dunne and Raby, 2013) or "alternative futures" (Blythe et al., 2016). This is in order to compare this world with our own, to imagine what kind of world we want to have. Unlike empiricism, speculation "thinks in the vicinity of the unknown" (Uncertain Commons, 2013). The empiricist attempts to determine the unknowns as risks which "eventually might be reached, grasped, and known" (Uncertain Commons, 2013). Whereas in speculation the unknown is inherently indefinable, incalculable and complex. The future of design has become less concrete. The work does not necessarily show proposals, the work shows provocations.

> The way speculative design creates objects to describe worlds is through the use of diegetic prototypes. Diegetic Prototypes are depictions of future technologies [that] demonstrate to large public audiences a technology's need, viability and benevolence…These technologies only exist in

[89] Just as design always has been with product longevity.

> the fictional world - what film scholars call the diegesis - but they exist as fully functioning objects in that world. (David Kirby, 2010)

This is a term from David Kirby (2010) that has been adopted into the speculative design lexicon from film theory. Design fiction being described as "the deliberate use of diegetic prototypes to suspend disbelief about change" (Bosch, 2012). The idea of suspending disbelief is theatrical, and like a film, it immerses the audience temporarily elsewhere. The context is not always visible, instead the elsewhere (or diegesis) is implied through the artefacts, revealing hints of its wider context (or its adjunctive concerns).

> The important word there is diegetic. It means you're thinking very seriously about potential objects and services and trying to get people to concentrate on those rather than entire worlds or political trends or geopolitical strategies. It's not a kind of fiction. It's a kind of design. It tells worlds rather than stories. (Bosch, 2012)

Kirby uses film theory to describe these artefacts as performative. *The Anatomy Lesson* as it was shown at the Science Gallery London, with pathological specimens from a bio-tech-body of the future on white plinths, implied the future dissection theatre where these procedures might take place. The work as it was shown at the Waag was slightly different, as well as the implied diegesis, the work was also placed within the diegesis of that space. A space in which imbedded in its brickwork, is a heritage telling the stories of a biotechnological past. This positioned the work within this narrative and as a result made its content seem less drastic when it sits amongst a tradition of modelling the body as followed in Chapter 3 (Body). The diegesis is intangible in both cases but it is built through a sensibility of reading the strategic links which tie the object to particular topics and concerns. In the Science Gallery the objects existed in isolation, the diegesis had to be imagined. At the Waag elements of the diegesis are present as the space feeds the work with further narrative.

The diegesis surrounding the work reveals that most of the interaction with the piece happens in the mind of the audience. The artefacts can reveal ideas and give them dimensional body, but the real takeaway is the trace of that idea left in the audience's mind. Zics (2008) refers to a similar exchange, one more salient in technologically-mediated artworks, in which meaning is created through "transparent medium" (Zics, 2008); that being technologically driven interactive artworks in the case of Zics' practice.

> When the habitual bodily action turns into a submersive capacity, a cognitive flow is produced at the mind-body nexus. It carries a potential for new knowledge in the form of an uninterrupted cognitive experience between the artist and the spectator, which is also referred to as an immaterial dimension of the artwork. (Zics, 2008, p.iii)

As audience members become immersed there is a process of ideas exchange between the maker and observer of the work, an exchange that happens in the mind of the audience. The diegetic prototypes are therefore not just props which allow the acting out of another world but instead they entertain ideas of worlds different from our own. Particularly of worlds that are intangible.

> design interventions can be seen as a form of inquiry that is particularly relevant for investigating phenomena that are not very coherent, barely possible, almost unthinkable, and totally under-specified because they are still in the process of being conceptually and physically articulated. (Halse and Boffi, 2016, p.4)

(iii) Design is speculative.

Design is generally a fictive practice. Ward (Speculativeedu, 2020) says that this is of course not solely a characteristic of design, everyone speculates, “we constantly imagine alternative material possibilities, mediating and negotiating a set of changing external variables.” The strong flavour of speculation in this adjunct form of design work is that it is concerned with bringing imaginative ideas to light. “Speculating is based on imagination, the ability to literally imagine other worlds and alternatives” (Dunne and Raby, 2013, p.70). Speculative design makes these imaginaries accessible. Speculative design could be compared to Jarry’s (Jarry, Edwards and Melville, 2001) 'pataphysics “the science of imaginary solutions, which symbolically attributes the properties of objects, described by their virtuality, to their lineaments.” If metaphysics is the study of the nature of reality, pataphysics is the study of the nature of the imagined. Rosenbak (2018) suggests that paradoxically design is a field inherently involved in creating knowledge through the imaginary but has for a long time lacked consciousness of this strength. Speculative design, sharing influences visible in dadaism and surrealism through its imaginary practices, crates new contexts or worlds which work sits inside. Similar again to the diegesis. Rosenbak (2018) argues that the move towards a form of design related to imagination[90] as seen in 'pataphysics shows that design is becoming more conscious of itself. This then means that design is

[90] To reiterate again, this is not to say that other forms of design do not imagine or promote imagination in a user, audience or public, but rather that it is just a concentrate focus of speculative design.

not just critiquing from the outside but can offer imaginary solutions from within them through accepting its association with artifice (Rosenbak, 2018).

> One convenient division of labour [cognitively] has been to assign the rational to the real and the irrational to the imagined. The inevitable realisation in scientific circles that the reality of the imagined has as an equivalent epistemological significance raises fascinating questions as it invites a sceptical reconsideration of the essential basis of knowledge. (Punt, 2004)[91]

Just because speculative design deals with the imagined it does not necessarily demote it to being irrational. The imaginaries that are formed from speculation may be a way of generating knowledge. This ability to imagine may be what Paola Antonelli (2008) describes as having an elastic mind, elasticity being "The by-product of adaptability + acceleration, elasticity is the ability to negotiate change and innovation without letting them interfere excessively with one's own rhythms and goals" (Antonelli, 2008). This may allow designers to explore complex topics such as the bio-tech-body whilst still offering insights to the discipline of design. Designers now "participate in making sense of things" (Hayoun, 2016, p.37) through imaginative practice of speculation. Therefore "the figure of the designer is changing from form giver to fundamental interpreter of an extraordinary dynamic reality" (Antonelli, 2008, p.17).

4.3. The Tissues of speculative design

Considering speculative design as an adjunct can be beneficial in two significant ways. Firstly, it means that applying the provisional, intangible and speculative filter to many organs of design means that the nomenclature for doing this kind of work is less of the focus than the content of the work itself. This will allow more attention to be given to whether the work is doing what it claims and may allow more discussion regarding the intricacies of the making to come into light; helping build sensibilities to enhance ways of doing design with this adjunct and include other topics and networks currently underrepresented. Secondly, considering this model as adjunct means that it is more accessible to other disciplines for which the membrane between is already becoming increasingly porous. This may allow other disciplines to take reference from design as Cross (1993) says this is predominantly a one way street from

[91] The argument in this paper is overarchingly about art and science but refers specifically to film and physics, although the points made most certainly can translate to the multiplicity of designs for the body expanding into parallel realities.

science toward design and that in fact there should be more references taken from design toward science.

The current models of design and the body have followed a similar path. The two are now driven not by the instability or the loss of a norm such as a basic datum or rigid methodological structure, but they are now driven because they both embrace provisionality, intangibility and speculation. The body and design have been conversing due to the sharing of stable reference points, but now they are conversing due to the force of speculation which invades both. The remainder of this thesis will outline ways that design can facilitate this manoeuvre. Chapter 5 (Body - Design) is an outline of how design may take ownership over the four strategies involved in this model of design, bringing design and the body in closer conversation to accommodate this shared move. Firstly, two tissues of speculative design are considered below that allow tactics outlined in the coming chapter to take place. These two tissues are what facilitate the porous membrane between the models of design and the models of the body.

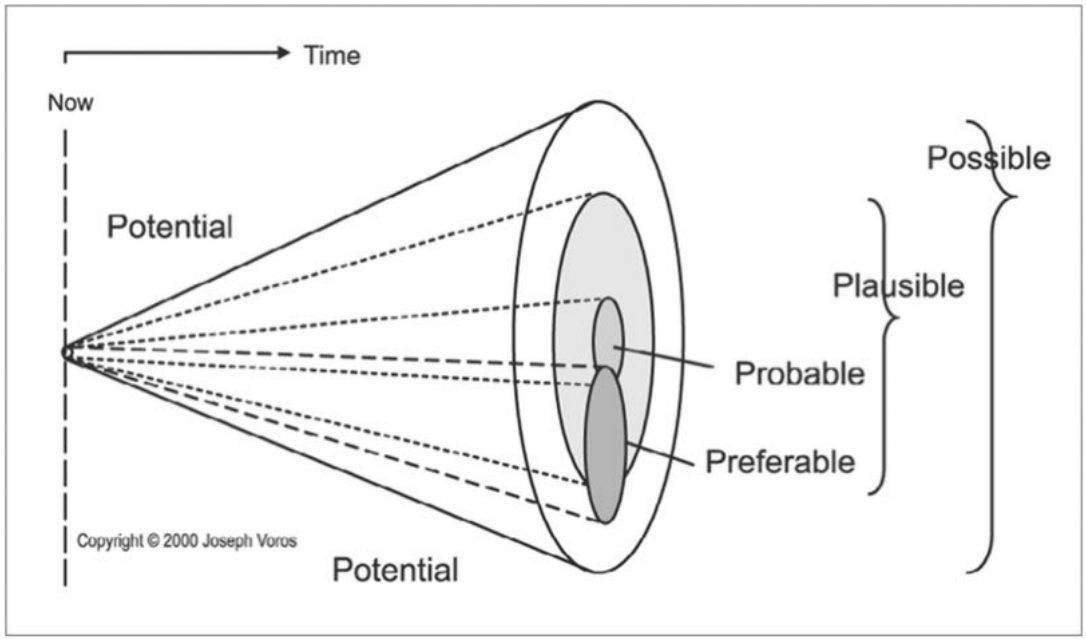

fig.19: **Voros (2003) Futures Cone**

4.3.1. Trajectories of the body

Work associated with the new paradigms of the body and design are concerned with points at which trajectories of these models might significantly converge. Not only to illustrate the potential convergence but also to consider whether the values of the

models at the point of contact might amicably overlap. Diagrams such as the futures cone (*fig.19*) and the futures wave show that these trajectories do not necessarily follow a linear timeline, but also show that these forms of design can exist along multiple timelines. In that a number of different effects may cause a convergence to sit at a different location on the cone, in the probable, plausible, possible or preferable trajectory (Dunne and Raby, 2013). According to Bleecker (2009), this design adjunct deals with the "course of events." Philips who developed *design probes* "intended to understand future socio-cultural and technological shifts" (Etherington, 2020). The example in this Dezeen reference suggests its ideas for a microbial home which could use home waste to power appliances was a nearer-term scenario. Which would sit on the narrower end of the futures cone.

These future visions are not proposals; they are platforms through which to bring surrounding matters of these convergences to light. This is made clear in the work of counterfactual histories and has been a helpful exercise not to consider certainties in what may have happened in the past, but instead to situate particular actions, people or events that have been of significant importance to history. Dunne and Raby (2013) suggest that the process of creating the counterfactuals of speculative design can help guide us towards better futures. Patrick Stevenson Keating (2014) for example, is not advocating that drug companies actually engineer pigeons to carry valuable data in his project *The Economics of Evolution: The Perfect Pigeon* but rather this work highlights "the commodification of biological information" and concerns regarding "how economic factors more than environmental ones, may overwrite natural selection" (Studio PSK, 2014). The work considers the convergences that might impact or alter the trajectory of the future; in other words, what are the instances that might trigger how we get there. This brings to mind the "Creative Entanglements" of Tim Ingold as he draws from the famous painter Paul Klee.

> 'Art does not reproduce the visible but makes visible' (Klee, 1961: 76) It does not, in other words, seek to replicate the finished forms that are already settled…It seeks, rather, to join with those very forces that bring form into being. (Ingold 2013a, p.210)

It makes the convergences along trajectories visible through engaging with provisionality, intangibility and speculation.

Speculative design is a practice whose conceptual rigor and purpose is often the main focus of critique regardless of the fact that it is still primarily a discipline that involves making[92]. The qualities of production are rarely the main focus of conversation regarding this type of design work. Collaboration with materials in the way that Ingold (2013b) describes in *Making: anthropology, archeology, art and architecture* is an aspect of speculative design that has derived from traditional art and design practices. He also writes;

> The practiced woodsman brings down the axe so that its blade enters the grain and follows a path already incorporated into the timber through its previous history of growth, when it was part of a living tree. (Ingold, 2013a, p.211)

In other words the designer works *with* the material. Design in this way is like the carvers knife mentioned above that finds the natural breaks of the body and parts it to investigate it manageably. The intervention Ingold makes here is that the breaks may be more possible to find by those practiced at collaborating with those specific materials. Therefore, design may be a helpful investigative tool in exploring the changing state of the body in order to discover the new breaks or new grain of this material through practice or alternatively through the supervision of others who are practiced in this material. According to Schön (1983) materials "talk back," "causing him to apprehend unanticipated problems and potentials. As he appreciates such new and unexpected phenomena, he also evaluates the moves that have created them." Design therefore has to "talk" with the new models of the body if it is involved in their design. When "'material speaks back' it does so by showing the designer its limits and restrictions, as well as possibilities, impossible to imagine without having them voiced in a concrete way" (Nelson and Stolterman, 2012, p.176). When designers sketch, prototype and make, the work speaks back by revealing the thinking, ideas and speculations that went into the work.

Schön (1983) describes an issue with the traditional models of medical practice not being applicable to larger healthcare systems because the system is a "tangled web

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[92] Bardzell et al.(2015) writes about an oversight in aesthetics in the project Menstruation Machine by Sputniko, a highly stylised project, in which he was surprised that the topic of aesthetics and making was left out of a debate at MoMA. "Finally, it is important to note that none of these readings take seriously the device's very sophisticated aesthetics. Yet the design, the artist statement, and the music video all collectively present a highly sophisticated and stylized way of being (which includes a futuristic, urbanized, Japanese, youthful, gender- bending, electronic, high fashion, special night out)—an ironic oversight indeed for a debate staged at MoMA."

that traditional medical knowledge cannot untangle." In regard to Ingold's writing on material agency, the body and design are not objects as anatomisation might attempt to position them, but instead they are things. It is "a certain gathering together of the threads of life", it is a place "where several goings on become entwined" (Ingold, 2013a, p.214). Ingold describes the flow between things as entanglements that have threads.

> The thing has the character not of an externally bounded entity, set over and against the world but of a knot whose constituent threads, far from being contained within it, trail beyond, only to become caught with other threads in other knots. (Ingold, 2013a, p.149)

The issue with anatomisation is that in the attempt to untangle the threads the models become forcibly moulded into another form. The models in this exchange are not conversing, as the cross over relationships between the threads in the knot are not being taken into account. When the entanglement has been straightened out due to anatomisation, it becomes challenging to reflect on the interaction and redesign without the two way exchange between the models of the body and the models of design.

fig.20: **Park (2013) Republic of Privacy: Dog Sniffer authentication. Photographed by Marcel Helmer.**

Speculative design's interest is to follow the threads that *trail beyond*; the threads of things that lead to knots currently unmade[93]. Potential knots can be made visible in different ways. Soomi Park's work shows representations of future knots. Her project *The Republic of Privacy* (Park, 2013), consisted of a series of objects, video, diagrams and imagery that represented a world where people share data with increasing scarcity. *The Dog Sniffer Authentication* (*fig.20*) is a tool in her imagined diegesis that dogs wear to retrieve money from a bank so as to expose less human data. Alongside this object, Park designed other tangles that might be connected to this knot, for example an ATM machine that used dogs as part of the authentication retrieval process, clothing to better use these tools and a scent holding bankcard. The objects she makes are often accompanied by rich imagery of the world with which that object is situated, where hints from this world can be found amongst the scene or across the world's ephemera. For example, a marriage ceremony in an increasingly privatised world might involve tools that reveal intimate information only to your loved one. Amongst the landscape of the ceremony is an embroidered ceremonial cloth with a dog's portrait found in the pattern, revealing the role dogs might have in this society as representatives of data carriers. These hints reveal interlinking tangles in the knot of a data-privatised future that not only asks 'what if we used dogs to manage data sharing', a somewhat comedic play on the current use of non-humans to mediate and store information, but that also makes visible aspects of the economic and religious complexities of this culture. The various aspects of this work show entanglements that reveal their complex interplay in a continuingly complicated world.

[93] This idea is the goal of speculative design to open up questions. This is disputed by Oliveira and Martins (2019) as they unpick the idea of yarning. Drawing on Donna Haraway's tangled ball of yarn which can be loosened "to universes without stopping points, without ends" (Haraway, 2004). They argue the ready made stories of speculative and critical design prevents loose ends "There is no call for the yarn to be untangled, no possibility for reply." This according to Oliveira and Martins (2019, pp.103-114) is when an audience can not relate to the work they become passive watchers. A successful piece which speaks to audiences on the other hand allows audiences to be active, supporting the insights of Zics above.

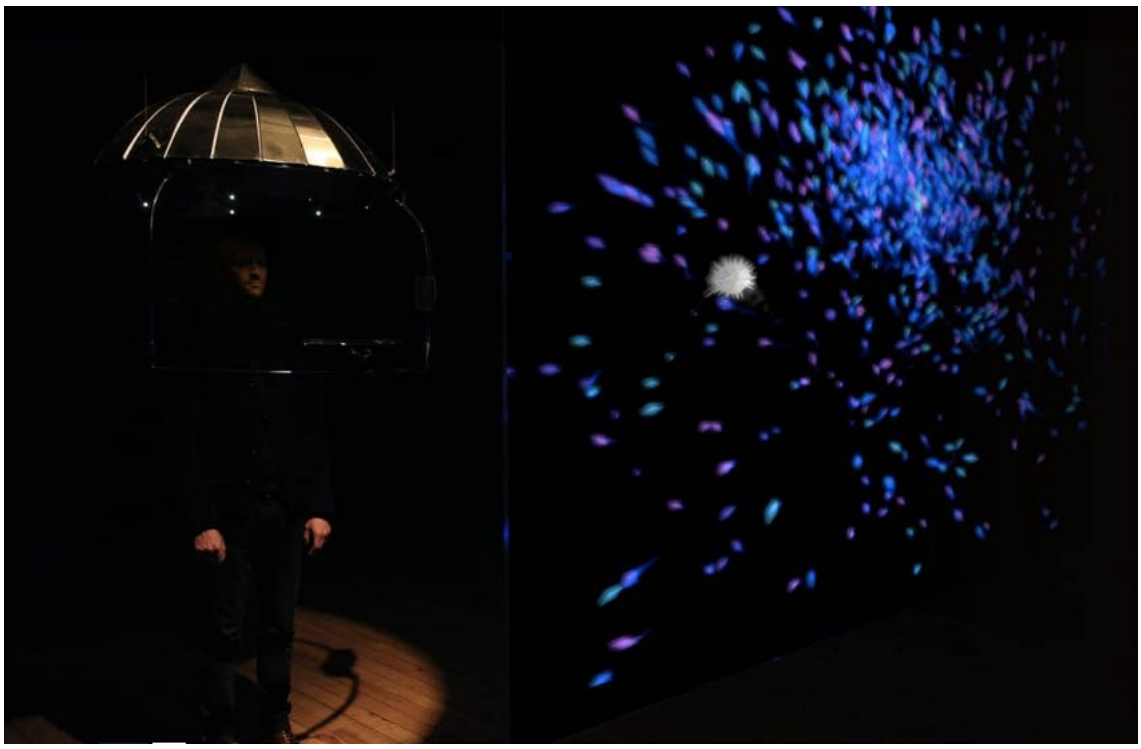

fig.21: **Zics (2014/2015) Eye Resonator**

In the project *Eye Resonator* (Zics, 2014/2015) an interactive installation by Brigitta Zics, audiences were invited to be involved in making potential knots visible. A large dome descends on the participant, playing audibly a selection of three scenarios: *Affective Recruiter*, *Boredom Machine* or *Self-therapy*. While the participant listens to the audio, the dome registers their eye movements to create algorithmic particle animations projected in front of them. As these three scenarios are posed the audience reflects on the experience differently based on the scenario selected and on their own response during the experience. Zics work predominantly uses cognitive interactivity rather than physical, and although the art production (tool) remains the same throughout the scenarios, the experience (medium) is varied as the experience is partly created by the spectator (Zics, 2008). Although ideation of course occurs when experiencing all art and design work, Zics' project makes clear the spectator's role as a responsible party in imagining potential knots, they are invited into this process as the scenario is played out.

The finding of potential knots is a method with characteristics that perhaps seem superficially similar to trend forecasting and product proposing, although the function is different. This is why some do not find value in searching for invisible knots that may not have clear or measurable later use, such as for predicting economic impact,

or governing technology etc. For speculative design, although interested in trajectories, the projects tend to not follow threads beyond the visualised knot. In Mike Michael's (2009) visualisation of how speculative design creates multiple versions of technologies they spiral in differing conceptual directions, although like other futuring methods their questions are engaging and alluring but are also "indistinct" (Michael, 2009). For the adjunct speculative design to therefore successfully facilitate sharing across the membrane between design and the body it should be thought of as an investigative tool through which to find possible convergences along the trajectories of these knotty things.

4.3.2. Opening up the body

Opening up is another intention of the adjunct speculative design, that may be of use in contributing to the constitution of the body and of design, as brought to light in Calvert and Schyfter's paper (2017). They write on how science and technology studies (STS) can learn from art and design, this paper is particularly notable as the territory of their argument is impactful for both the body and design. It is in the context of a large collaborative work regarding synthetic biology that led to the book *Synthetic Aesthetics* (Ginsberg et al. 2014)[94]. They comment on speculative design in relation to the work of Stirling regarding *opening up*. Stirling proposes that in the governance of science and technology *opening up* may lead to different conclusions, may raise alternative enquiries and may be driven by societal values that are inclusive of vulnerable and marginalised perspectives that are often left out[95]. Calvert and Schyfter (2017, p.202) condense Stirling's description of *opening up* as "drawing attention to the often implicit assumptions that underlie discussions of a technology," in the case of the collaborative work described by Calvert and Schyfter, regardless of discipline all involved shared the aspiration to *open up* the technology in question. Calvert and Schyfter state that the insights from these collaborative efforts may help inform an emergent form of critique. This definition shares similarities to Dunne's description of critical design in *Hertzian*

[94] Synthetic Aesthetics is a book by Daisy Ginsberg which outlined the result of a number of collaborative design works between various artists, designers and scientists on the subject of synthetic biology.

[95] There have been arguments regarding speculative design not being open enough to marginalized perspectives. Guess (1981) describes these types of design as elitist. Although there is definitely more work to be done that welcomes these perspectives further. There are also distinct characteristics of speculative design that welcome more exploration in these areas, hopefully more designers will begin to tackle areas or questions that are currently lacking, and support *opening up* in the way Calvert and Schyfter describe it. More on this in Chapter 5 (Body - Design).

Tales (2005) as able to "challenge its audience's preconceptions and expectations thereby provoking new ways of thinking about the object, its use, and the surrounding environment" (Dunne, 2005, p.63).

Art and design now have an intimate involvement in public engagement with science and technology (PEST)[96]. The attachment of artists and designers in scientific research often is an attempt to further engage wider or alternative audiences. In the talk show *Create out Loud #3* at Dutch Design Week 2015 on "science and research" Robert Zwijnenberg, professor of Art and Science Interactions, at Leiden University suggests designers can *open up* through disruptive ideas and new perspectives. This, however, involves designers being immersed fully into the process. In this discussion, Danielle Arets from Design Innovation Group at Design Academy Eindhoven swiftly reminds the speakers of the distain from designers in becoming "lapdogs for science". In which the designer's role is to illustrate or make visual or beautify ideas that are currently (as Koert van Mensvoort, founder of Next Nature Network, says) "dead wood," referencing scientific papers that, regardless of containing worthy insights, are otherwise ignored or unread. With interest in science and technology, and a penchant for alluring aesthetics, speculative design is at high risk of becoming a communicator that takes on the role of a creative and zany partner to a successful scientific pioneer who might benefit from trying their hand at differing forms of conveying or even publicising their research. On the other hand, a designer may also own or bastardise scientific research. "Standing on the shoulders of giants," Mensvoort here refers to those who have spent a whole lifetimes work on a topic which may be picked up by a student project and presented as partly scientific research. Take my project *Circumventive Organs,* which is based on research into regenerative medicine, particularly that of Anthony Atala at the Wake Forrest university. Although in no way making the claims of science, this work takes from the research and extrapolates it in the way that they might image this work within their lab should it become a reality.

The mixing of speculative design and PEST is a relationship greatly explored by Tobie Kerridge (Kerridge, 2015). He suggests that speculative design has morphed from a specialism that was mainly a form of critiquing traditional industrial and product

[96] For a comprehensive outline of public engagement with science and public understanding of science see Wynne (1996).

design methods and has more recently become involved in public engagement. His ultimate analysis suggests that this mixture has helped form a model of practice-based design research that may be of use in future speculative design collaborations and formats. An example of a moment that surfaced during *The Anatomy Lesson* event outlined in the case study will be the example for a number of factors that show how speculative design might support *opening up* the body in reference particularly to statements made by Mike Michael regarding engagement events.

The context in which this interaction took place are as follows; *The Anatomy Lesson* was facilitated by guides, particularly myself who steered participants through the exhibition. This was not only to enhance the experience but was also due to the number of harmful medical tools including Dremels, scalpels and other sharps that were usable by the public. The interaction with the audience encouraged participants not to use sharps without the assistance of a guide who would then talk the user through the use of the dangerous tools. The work had the quality of semi-realism, yet the objects were designed to be interactive in specific ways that were afforded by the tools provided. Each workstation contained the tools only appropriate to its corresponding sculpture. For example, for the *Terratoma Tooth Transplant* sculpture there was a segment of replaceable bone to be cut by participants using a Dremel. The area to be cut was made in order for the Dremel to easily penetrate, but the surrounding resin made bone was difficult to access and harder to Dremel into, indicating the area that the Dremel should be used upon, also further indicated by direction of the guide. This direction was to prevent any injury to the audience but also aimed to restrict the interaction so as to focus the audience's attention to the principal feature of the work; the technology.

Whilst all guides were otherwise engaged with participants one member of the public, against indication by exhibition signage, took a scalpel from one table to another and began cutting into a section of a sculpture not intended to be sliced. In a supervisory meeting with Mediamatic prior to the production of the work, Willem Velthoven[97] rightly warned me of the dangers of this taking place and exclaimed (which I briefly noted in my journal notes of these discussions) "at your own risk - but its going to be an expensive piece of work in money and time" in reference to me fixing the work every

[97] A supervisor from 3Package Deal Bio Design coalition at Mediamatic.

time an interaction I could not control might take place. A piece of advice that resurfaces every time I am sitting at a desk somewhere repairing or ordering further materials to repair the sculptures. In spite of the work being cut in an irreparable way this untamed interaction has lingered for reasons other than cost of time and funding.

The unexpected interaction brought to light qualities within the work that also exist in other speculative design projects which contain means of *opening up*. The moment yielded ideas regarding the work in reference to its physical presence and content regarding the technology in question. The sculptures, like many speculative design projects, exist at the fringes of design. They share likeness to other formats, but as a result do not sit comfortably within one. The sculptures are not quite design products, nor are they pieces of art, nor simulation objects, nor real specimens but share aspects of these formats. Like design products, the sculptures were made with the intent to be handled and interacted with and also had a specific function. Like a traditional piece of fine artwork the sculptures were made using sculptural techniques, being costly, one off and time heavy to produce and presented in a somewhat gallery-like arrangement. They do not have the longevity or pedagogical intent of simulation objects, and although may appear like real specimens are of course made mainly of plastics. To predict an audience response based on typical interactions in these singular formats is a challenge, but this hybrid presentation can be considerably confusing territory for an audience. This was also heightened by an experience with lack of rules and boundaries. As the work was supposed to be in the context of a future anatomy lesson, the audience were a part of the performance and although unexpected, this interaction was in line with this imagined scene in the diegesis set up, and the audience had the freedom to act as they pleased.

As Michael suggests in his paper *What are we busy doing?: Engaging the Idiot* (2012), speculative design makes virtue in what he calls the *overspilling* of public engagement events. Michael describes there being a gap in attention to these aspects of events due to the sanitisation of the outputs. He describes *overspilling* as;

> happenings which, in one way or another, ‘overspill’ the empirical, analytic, or political framing of the engagement event. Lay participants ‘misbehave’ in various ways – they ‘overspill’ the parameters of the engagement event. (Michael, 2012, p.528)

This results in interactions in which the outputs are surprising and cannot be controlled. The interaction that took place during *The Anatomy Lesson* left an imprint regarding the nature of speculative work. It brought to light the argument that although speculative design work often claims to promote discussion (Dunne and Raby, 2013) this is rarely captured. I considered questioning the audience member on their intentions but instead allowed the interaction to take place as we noticed it unfolding to keep in line with the performance. With optimism, I arrogantly imagined that they were so engrossed in the performance and they were playing out the role of an inquisitive medical student. Other conjectures on their intention could be that they may have wanted to probe the realism of the objects further as the slice they made reveals a less than lifelike segment. Or perhaps there is just enjoyment in the freedom to destruct the piece that may have been attractive. Or the instructions were not sufficient for this audience member to understand or for myself as a designer to have full control. Regardless of intent Michael (2012) describes this anarchistic behaviour of the audience as "proactive idiocy" [98] in that the insights often gained from their interactions "engender invention" leaving memorable and insightful traces that exist beyond the work itself.

[98] Idiot here is not derogatory but rather a hero of the event. He describes this character in relation to Isabelle Stengers (2005) vision of the 'idiot' in her cosmopolitical proposal.

fig.22: **Pisanty (2011) With Robots**

Speculative design teases the line between ‘mundane’ and ‘exotic’ technologies (Michael, 2003). In Michael’s book *Reconnecting Culture, Technology and Nature* (2002) he portrays two visions of technology, one as being mundane and the other as exotic. The mundane are those that are “doing their ‘job’” and the exotic are “considered crucial in the reshaping of the social, the cultural and the human” (Michael, 2002). As Michael puts it the distinction between these types of technologies is “spurious” but the exotic is often perceived to be more vital in reshaping due to the discursive interest and attention these technologies get. Speculative design plays with the difference between the types of technologies mentioned by Michael by shifting the “amazing” and the “boring” or the “believable” and the “incredible” (Sterling, 2013), by altering its context or adding something to it’s knot. An investigative cut would be

mundane for those working the context of a cadaverous research lab for example[99], but in a gallery this is exotic. Diego Trujillo Pisanty shifts the exotic into the mundane in his project *With Robots* (Pisanty, 2011), in which his photographs of home details that have been modified for a life with robots makes this exotic idea seem quite normal (*fig.22*). The objects in his imagined home feature codified icons, shapes and modifications that might make it easier for robots to manoeuvre the domestic environment. For example, cups that have handles more easily held by robot arms and symbols to denote positions of the cups on a cupboard shelf.

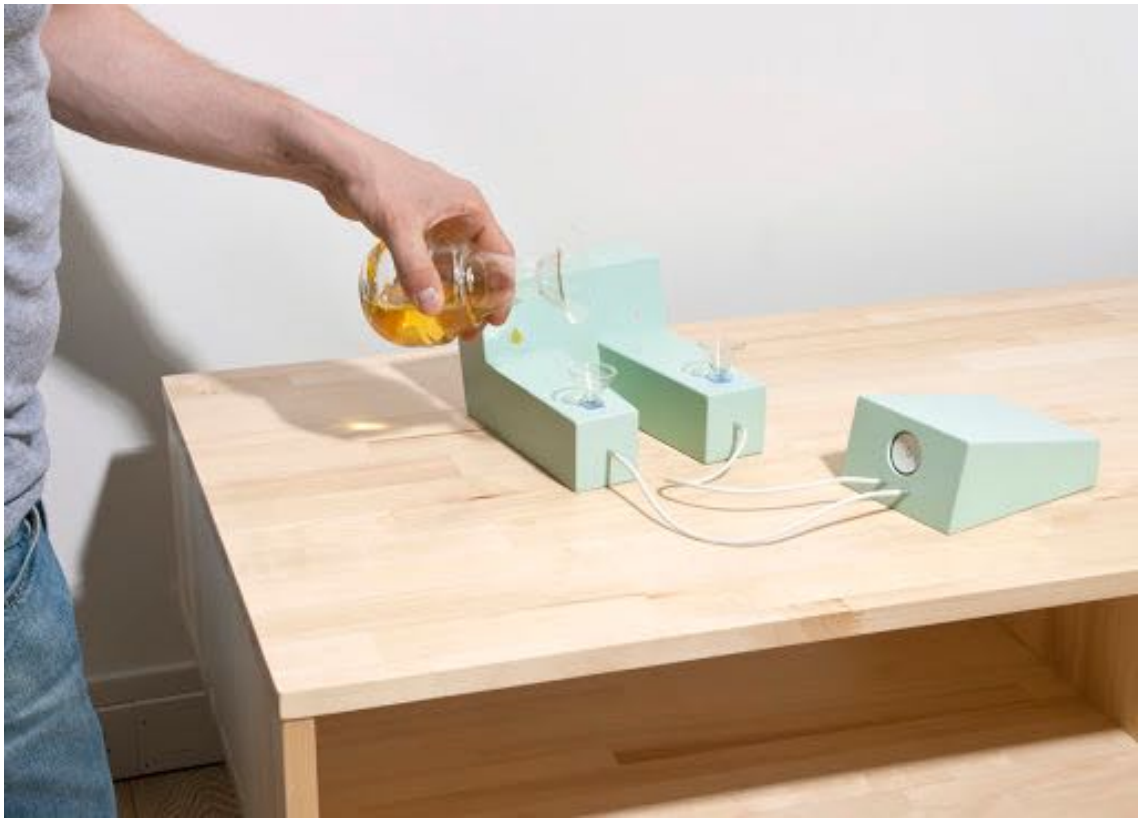

fig.23: **Thought Collider (2012) Aqua Vita. Photographed by Lauren Hillebrand.**

Thought Collider, on the other hand, make something mundane into something exotic in their project *Aqua Vita* (2012), in which they make visible the importance of urine not as a waste but as a biofluid (*fig.23*). They self monitor their urine and create speculative

[99] The specimens available at a cadaverous research lab have a shelf life, and simulation models are built with robustness in mind, both types of objects call to be used yet their usage is mainly by professionals or specialists. As experienced first hand during my research visit to cadaverous research laboratory, Erasmus MC Anatomy department facilitated by Dr Marcel de Jeu. The real specimens were respected objects that were used extensively for exploration; no parts of these were spared so an investigative cut would not be unusual. Alternatively during my visit with TransTechnology to Torbay simulation lab the mannequins are robust and made to last. They are designed to prevent unruly cuts so damage can be avoided or specific parts do not need to be replaced. The sculptures although visually more similar to the real specimens than the caricatured simulation models were made from the same materials as the mannequins.

recording devices that might facilitate the capture of this data to reinstate urine as an important and complex fluid whose data informs health. The already apparent weaknesses in fantasy and pretence of technologies are what make the *trickery* of teasing these boundaries possible (Stirling, 2008). The reason why this is interesting for the body is that knowing that the body is now also a technical object, as it is situated in Chapter 3 (Body), it contains elements of both the exotic and the mundane. The bio-tech-body may become harder to distinguish from the mundane body, making the body a potential site for further *trickery* (Sterling, 2013). The somewhat enigmatic nature of speculative design captured in the form of *overspilling* and *trickery* suggest the designer may have more freedom as they can introduce hybrid notions and play with the fringes of other territories.

The lack of boundaries or freedom might also invite exchange at the membrane between the body and design. The adjunct speculative design therefore might be a way of inducing *opening up* when exchanging ideas, as there were not limitations to time, possibilities or interactions being imposed on the audience or on the discussions in making this work. This is not to say that this adjunct design is completely free, it is still constrained by comprehensible communication and making processes but it may be more freeing than systematised forms of design. In which case it may have an increased mobility in thinking to explore both the mundane and the exotic and to overspill in order to discover things about the complex topics in question that otherwise may not have been accessible to the designer alone. Opening up the pores in the membrane.

4.4. Design develops intellectual autonomy

4.4.1. Conclusion

Chapter 4 (Design) has described how the anatomisation of design can be somewhat compared to the anatomisation of the body. Like the body, design has been understood through segmenting it which has created a static vision of design. A move away from orthodox design methodologies has revealed a paradigm shift in design towards the provisional, intangible and speculative. These characteristics seen in speculative design span across many organs of design and should therefore be considered as an adjunct to the organs of design. Two tissues of this adjunct are that it is concerned with *trajectories* and creates work about where convergences might happen

along projected trajectories, and that it may also be involved in *opening up* topics which may lead to different design conclusions. These tissues position this adjunct as a facilitator across membranes, one which can act as an investigative tool to find hybrid concerns and then share them through the processes of making artefacts which encourage ideas exchange.

On the one hand, anatomisation can be advantageous for separating the field of design into specialisms with specific functions. Anatomisation at the minutiae can also be helpful for sharing with those external to design, in that during collaborative work terminology can be integral to express various intentions of the work.

> For collaboration between individuals to occur, there is a need for information to be exchanged. Inevitable differences between the multiple vocabularies of the individuals necessitate the negotiation of translations or mappings between the vocabularies before effective information exchange can take place. (Punt and Denham, 2017, p.6)

This terminology should not be considered a brandishing of that term in design, these terms can shift and change. When Dunne and Raby developed the term *critical design* they suggested that naming it as such was "simply a useful way of making this activity more visible and subject to discussion and debate" (dunneandraby, n.d.). The title realigns the lens so particular aspects of design can be focused into attention.

Matt Malpass (2012), like Nigel Cross (1982) calls for a richer designerly language to discuss critical design that does not borrow from other disciplinary vocabularies. Although the fringe nature of this design specialism means that its shared forms may create a language that borrows a selection of terminology from local disciplines whose language permeates the borders of speculative design, especially if there are some arguments for fewer design terms, as in Tonkinwise's *just design* debate (2015). Malpass calls for a denser consideration of current terminology that is tailored for and situated in design practice[100]. It may be contradictory to aim the knife of design study elsewhere, but it seems that anatomising this adjunct of design might be preemptive if it is drawing focus away from the content of the work itself. Kerridge (2015) suggests that the debate can be undermined by an agenda to promote a novel design practice. Alternatively perhaps the anatomisation of this adjunct design should currently be focusing on finding terminology which is used to describe the type of work

[100] His thesis on contextualising critical design proposed a new taxonomy of design practice (Malpass, 2012)

created or the strategies used in this form of design, this may better help shape the intent of the design rather than the attempt to focus on umbrella terminology to express it wholly.

> Design is emerging as a new discipline of practical reasoning and argumentation, directed by individual designers toward one or another of its major thematic variations in the twentieth century…The power of design as deliberation and argument lies in overcoming the limitations of mere verbal or symbolic argument —the separation of words and things, or theory and practice that remains a source of disruption and confusion in contemporary culture. (Buchanan, 1992, p.19)

Current design terminology such as "function" (Malpass, 2012) therefore can be more tailored for and situated in design practice. Rhetorical accounts of design projects from design practitioners, design writers, curators, social studies of science, archeology, philosophy etc, is still situated through the filter of disciplinary and specialist knowledge (Kerridge, 2015). To keep in line with this form of design as adjunct, a shared language may allow design to draw from these differing rhetorics to better support practice rather than limit it.

It is the designer's responsibility to consistently be cognisant of humans and human bodies interacting with their internal and external context. The nature of design is to forever consider the alternatives, to better the previous iterations; how can designers make things increasingly efficient, increasingly sustainable, increasingly economic, increasingly influential, increasingly lucrative etc. (Verbeek, 2005). It is the designer's job to find, search and improve. Design is not only a matter of solving problems but of seeking the appropriate problems. In this case, design is not only an instrument to shape and change artefacts and the systems and processes surrounding them, but also an investigative instrument that considers the wider ecosystem of artefacts through reflection on the models of design practice.

Through taking ownership of terminology associated with design, the practice of design becomes involved in generating knowledge. Through the tissues of this adjunct it invites those external to the discipline of design to come into orbit with the work, giving design authority as a means through which to discover and research as well as a tool through which to find successful strategies of communication. "Professional design practice today involves advanced knowledge" (DiSalvo, 2012, p.xii). Through paradigm shifts in redesigning the models of design in turn will contribute to redesigning the world (Escobar, 2017). Design is "the most powerful tool

with which man shapes his tools and environments (and, by extension, society and himself)" (Papnek, 1984). Therefore, redesigning the models of design may be a long form process of instigating change.

The leap frog effect of design catching up to facilitate science in the previous chapter might be what speculative design is somewhat making up for. Speculative design allows design to not be awaiting changes in science for it to alter its own trajectory. Instead speculative design gives design some autonomy as it allows design to move in line with the body or even before, in anticipation of changes within its modelling.

5. BODY - DESIGN

5.1. Design engages with new forms of body

Chapter 3 (Body) outlines the journey of the body towards a provisional, intangible and speculative body. Chapter 4 (Design) shows that the trajectory of design can be somewhat mapped onto this trajectory of the body. These studies have shown that both the body and design move away from fixed reference points towards ambiguous references. In light of this shift new visions of the body and new design specialisms have emerged, which converge with one another through the re-conceptualisation of materials. The materials of these subjects have changed to incorporate the invisible (to the naked eye, for example the molecular or the future etc.). A nexus of this convergence is speculative design, an adjunct specialism to design which is a product of thinking of the materials available to design differently. This adjunct design gives licence to designers to access or deal with the provisional, the intangible and the speculative; all characteristics of the material of the body has now become.

As Bardzell et al. (2015) briefly mentions that speculative design shares some of the immediate pragmatic goals of research through design (explored briefly in Chapter 4 (Design). This chapter will outline a number of tactics that make these goals possible: "to explore the expressive or functional capabilities of a new material… to help a designer creatively explore a problem domain" (Bardzell et al., 2015). The tactics outlined are not a 'how to' guide but instead they are an "annotated portfolio" (Gaver, 2012)[101] which presents theories and examples of tactics that designers have used to successfully explore the new material of the body with all its complexities to prevent reduction. This will allow design to explore what Bardzell et al. suggests is not often the intention of the designer but an impact of research through design objects "to engage

[101] Gaver says "an endless string of design examples is precisely at the core of how design research should operate, and [..] the role of theory should be to annotate those examples rather than replace them" (p938). Gaver, W. (2012). What should we expect from research through design? In *Proc. of CHI'12*. ACM.

debates in aesthetics and philosophy of science about what constitutes 'knowledge'". This chapter will explore the language that supports the distribution of this knowledge or rather how this knowledge and the ideas surrounding it are exchanged.

Just as anatomy has re-conceptualised the material of the body, speculative design has re-conceptualised the materials accessible to design. Nelson and Stolterman (2013) suggest materials for design extend from the immediately tangible to the temporal and ephemeral.

> Material, as we use the word here, is not limited to physical materials like water, iron, paper, and biologic matter. It also applies to the abstract material used in the composition of a process, or a symbol, or system, such as number, essence, and nature. It applies to people as social, cultural, and spiritual material. Materials are what a designer brings together using structural connections or compositional relationships. Materials are what a designer uses to midwife a design into its existence in the world, to make it appear and be experienced in a real sense. (Nelson and Stolterman, 2013, p.175)

If the body has then become a new material for design, not only in the concrete sense that a designer may make products with the blood or the viscera[102] but also the provisional, intangible and speculative elements of the body. Then to design with this material involves craft.

> Giving birth to a design is a matter of craft. Craft is the skill set a designer needs to use when working with the right materials, in the right proportion, with the right tool set in order to produce a final desired, designed outcome. (Nelson and Stolterman, 2013, p.173)

Then what skill set does a designer need when crafting with the provisional, intangible and speculative human body?

DiSalvo (2009, p.55) describes the design skill of Dunne and Raby as "thorough and expert." He suggests the way they "make apparent" (in the same way Nelson and Stolterman use "make it appear"[103]) is with "sophisticated attention to the aesthetic characteristics of possible future conditions" (DiSalvo, 2009, p.55). Nelson and Stolterman (2013, p.151) call this "connoisseurship," it is the ability to take from and implement experience to traverse complex problem spaces. It is not immediate but is developed over time through practical training and lived experience. Similar to Erlhoff and Marshall's (2008) defining skills in design as a learning process. The skill set must then be built upon for it to flourish and mature. "'Skills' implies gaining a

[102] Basse Stittgen (2017) or Debatty (2015) on Isaac Monté's work.

[103] This is perhaps in relation to Seel's "aesthetics of appearing" (2005).

proficiency that enables one to do something" (Erlhoff and Marshall, 2008, p.361). It is this building which differentiates skills from the innate characteristics of abilities (Nelson and Stolterman, 2013).

5.1.1. Design Tactics

The elements of design skills brought to light in Chapter 5 (Body - Design) are those involving communication of ideas. This may be described by Tharp and Tharp (2018) as how the aesthetic and experiential elements of the "message-form" convey the "message-content." Message-form being "the structure of the messaging or the mode of discourse" (ibid., p.551) and the message-content "encompasses the specific ideas and information that are conveyed" (ibid., p.551)[104]. For DiSalvo (2009, p.60) these elements are *tactics*, they are what help communicate through design objects, "tactics are designerly means for the identification and articulation of issues; such that they might be known enough to enable a public to form around them"[105]. Tactics elicit responses which draw people towards the ideas or issues at hand. Speculative design, like design fiction "doesn't have users, it has an audience" (Mollon and Gentes, 2014) so in the case of speculative design, tactics should involve concrete means through which to communicate with and elicit responses amongst an audience. DiSalvo (2009) calls this "constructing publics", publics are constructed through the gravitation of groups through and around issues or topics.

> …issues themselves do not exhibit the agency to assemble people. Rather, it is the actions and effects of others communicating issues and their consequences, that prompt a public to come into being. This act of communication is both a problem for the construction of publics and a place where design contributions occur. (DiSalvo, 2009, p.51)

For designers, then to craft with the models of the body the skill set needs to hone tactics which engage or speak to publics. These tactics can guide craft so that the "final desired, designed outcome" (Nelson and Stolterman, 2012, p.173) communicates with the publics in a devised way that converts them from being viewers to being "questioners" (Mollon and Gentes, 2014). The designer's goal is not necessarily complete when a design communicates well externally, it is not a "hard skill" that has

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[104] "Ten primary forms are presented that are helpful in the ideation process: analysis, description, classification, exemplification, definition, comparison-contrast, analogy, narration, process, and cause-and-effect." (Tharp and Tharp, 2018) Influenced by Frank D'Angelo's ten modes of discourse.

[105] Here DiSalvo (2009) draws on *The Public and Its Problems.*

an end (Erlhoff and Marshall, 2008, p.361) or is complete at the production of a designed object. The designer is instead a member of the public, they construct the public around them and are a part of it. Just as the fork was a design responsible for changing the shape of the teeth outlined in Chapter 3 (Body), the designer should be engaged in this ongoing process. For example, capturing and being mindful of the impacts, and reevaluating this object to develop in tandem with the changing technological and bodily environment. So the designer's goals "to explore the expressive or functional capabilities of a new material… to help a designer creatively explore a problem domain" (Bardzell et al., 2015) continue after the making of the work in many formats. The selected portfolio of tactics below, like much PhD exploration, is a way for me and my design practice to extend and become part of a public in the issues surrounding the bio-tech-body. By adding to previous knowledge of these tactics and drawing from them in ways that better situate my design work. As well as to fortify design skills in use when crafting with the body, so as to seed or promote connoisseurship for designers dealing with the new materials of the body (like myself)[106].

> …the danger is it [speculative design] becomes a design label rather than an activity, a style rather than an approach. (Dunne and Raby, 2013, p.34)

Tactics used in design which suggest the intentions of the design specialisms mentioned above might be understood as more than just a design style choice. As above some of these tactics have been reinforced by the work currently originating from a locus limited to those in connection to its originators (for example the Design Interactions course at Royal College of Art and beyond). The use of design principles inspired by predecessors across multiple artefacts and stylings result in recognisable aesthetics. Currently speculative design does have a style, which is visible in the tactics it uses, not just informed by its originators but also by the culture and societies in which it was conceived. But as this expands new tactics have already been developing that introduce novel aesthetics and ways of communicating, particularly as speculative design becomes increasingly an adjunct to other design specialisms.

[106] The tactics below are broken down into specialised parts. The anatomisation of these terms originally cut by other disciplines and borrowed here to be made useable in the language of design.

fig.24: **Robert Kovacs, Pedro Lopes, Patrick Baundisch, Alexandra Ion and David Lindbauer (2017) Ad Infinitum. (plopesresearch, 2017)**

At the *2050* conference in Hangzhou, Andrea Bandelli and Hrund Gunnsteinsdottir presented a live talkshow on *Technology + Design* (2050, 2018), Bandelli presented a number of artworks that had been on show with Science Gallery International. This included the work *Ad Infinitum: a parasite* by Robert Kovacs, Pedro Lopes, Patrick Baundisch, Alexandra Ion and David Lindbauer. This machine is a "metaphor for control" (plopesresearch, 2017) which enslaves an audience member to push a crank (*fig.24*), if they cease work the machine will electrocute them, stimulating their muscles to continue, "you experience the shift from user to used" (ibid.). This artwork represents complex relationships between human bodies and the bodies of machines. The used audience member can not be released until another takes their place, the human machine interaction is brought closer together as the human body becomes another cog in its working. An interesting parallel to the data sharing of users who become used through the sharing of information now powering companies such as Facebook. In an anecdotal reference, a designer that was sitting next to me during the talk lent over to share with me their disgust for the design, in a whispered conversation to define the core of their disgust it was that they did not see value in this type of critical work. This piece which is highly visually communicative about the current state of HCI

using utilitarian rhetoric, the horror of the crank in a fashion reminiscent of Edgar Allan Poe, simply did not speak to them in the way it spoke to me.

This brings forward the argument that speculative and critical design work such as this has a public mainly consisting of a small bubble of designers[107] but also that it is a matter of taste. Taste may be reinforced by a growing appreciation of this type of work (speaking to the converted) or it may be a characteristic of publics, there are a vast number of reasons why this work may not have spoken to this designer. To take an example, the first tactic outlined below is humour, humour is of course not always consistently transferable across geography, ideology or even necessarily across individuals[108], particularly when it may be coming from a contested angle. Or as Freud might put it "only jokes that have a purpose run the risk of meeting with people who do not want to listen to them" (Freud, 1960, p.136). Similarly in product design, a particular chair may be garish to some and stylish to others. Speculative design is of course affected by the same constraints, it comes in different forms but still taste is an impacting force on the reception of the idea. This is what Desmet (2004) called *attitudes*, which are dispositional likings or dislikings which are innate or learned. If a design corresponds with an attitude it is "appraised as appealing and will elicit emotions like attraction" (Desmet, 2004, p.10). The argument of Bandelli here was to encourage a diversity in design and technology artefacts that is inclusive of differing positions and points of view. His decision to show this work was to expand the type of design work on show at this conference so as to involve other publics. This brings back the notion of "constructing publics" (DiSalvo, 2009), the tactics involved in the craft of this work does not articulate to everyone in a uniform fashion, but designers can consider how they can construct who it is they speak to and how the information is conveyed. Publics may share interests which encourage the gravitation towards particular issues but are

[107] and those involved in the language of the exhibition (Oliveira and Martins, 2019) as the work is mainly exposed physically through galleries, museums and universities these spaces "are strongly segregated by social and economic markers such as literacy, class or economic power." Although this does not reach wider publics it can speak to those connected to the topics in alternative ways, for example *The Anatomy Lesson* has connected me not only to scientists who's work relates to the various fields connected with the work on show but also filmmakers and prop makers, prosthetic designers and scientists replicating human tissues as well as simulation technicians. Although perhaps extending to sister fields these are still as Oliveira and Martins states predominantly in academic and professional satellite discourses related to their positioning of the gallery format.

[108] "although emotions are idiosyncratic, the conditions that underlie and elicit them are universal. Those theories indicate that each distinct emotion is elicited by an unique 'pattern of eliciting conditions' (Lazarus, 1991)." (Desmet, 2004).

still built of individuals none the less. “The assertion that publics are not a priori existing masses is central to the notion of the construction of publics” (DiSalvo, 2009, p.49).

One singular issue may result in multiple publics, as DiSalvo points out cultural attitudes may produce multiple publics with differing opinions and attitudes. Disparate interpretations of the same artefact produce a multiplicity of publics whose response to the object shapes them into groups (DiSalvo, 2009). The argument that speculative design comes from a position of privilege (Martins, 2014) suggests that there needs to be more work which involves perspectives of currently underrepresented cultures (Thackara, 2006), classes (Ansari, 2015) and genders (Martins, 2014). As the work occasionally deals with shared issues or fears without using tactics that inclusively and successfully speak to these publics[109]. In an axiom attributed to William Gibson — the future is already here - it’s just not very evenly distributed. Increasing the spread of speculative design by designers such as Paolo Cardini in his *Global Futures Lab* workshops (Cardini, 2020) extends the craft of speculative design to local communities sharing the methods to other publics and diversifying the rise of designers tackling these topics[110].

In both of the design goals above the most salient element is ‘to explore’. In Daniel Fallman’s Triangle of Design Practice, Design Studies, and Design Exploration;

> …design exploration is a way to comment on a phenomenon by bringing forth an artifact that often in itself, without overhead explanations, becomes a statement or a contribution to an ongoing societal discussion. (Fallman, 2008, p.8)

This ongoing shared and ‘soft skilled’ design work means that the addition of new artefacts and the connoisseurship of tactics can involve and accumulate new and underrepresented publics. Just as the principles associated with the Bauhaus originally had a limited heritage, its engagement across the globe has now encouraged this once limited design methodology to expand. As Fallman (2008, p.8) says it is exploration through which space is made to “acknowledge and take seriously the issues of

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[109] For Blythe (2016) “our appreciation of it [critical design] can indicate our inclusion in a group or political affiliations it can also be a status symbol. Like critical art, it is sometimes ultimately a commodity, easily absorbed into the social order it condemns.” In reference to Dunne and Raby auctioning a piece of work.

[110] Unconscious bias is visible in many works, mine included, for example engaging with medical technologies that are not available globally, through the perception of futures imbued by socio-cultural status, geography and heritage of the designer.

aesthetics," so more design exploration is needed to build upon this ongoing design work. Defining and shaping the tactics involved in the construction of publics.

5.1.2. Design tactics and the body

Below are four tactics used in speculative design; humour, irony, horror and disgust. There are of course other tactics, such as, ambiguity (Malpass 2013, Gaver 2012), paradox, pun (Klein, 2014), projecting and tracing (DiSalvo, 2009) etc. The reason the four tactics outlined below are of importance is that they are tactics I implement often within my own design practice; this is an internal exploration from the knowledge gained from practice as well as external from observation of the practice and artefacts of others. Most importantly these tactics have a potent relationship with the body at the psychological and physiological level (Cupchick, 2014). They draw out an emotional and occasionally proprioceptive response in the form of an internalised grapple with dissonant concepts. The heuristic elements of tactics will be unpacked rather than the designer's intention, which in terms of speculative design is to not be reductive (Bardzell, 2015)[111], so to extract a simplified intention here seems in contradiction to the polysemic nature of speculative design work. Rather, the purpose of revealing tactics is to show how projects have elicited a response that brings the body in conversation with design through the use of these tactics. As the body has now become extended to be formless and expansive (provisional, intangible and speculative) then these tactics are means through which this extension is facilitated by design.

Tactics are a way to tease the audience's interests and feelings (Mollon and Gentes, 2014). Mollon and Gentes compare the elicitation of emotions with fighting a case, (drawing from Aristotle) they suggest that without full knowledge of a topic people can feel their way towards a decision. As Schön (1992, p.11) writes "the designer constructs the design world within which he/she sets the dimensions of his/her problem space, and invents the moves by which he/she attempts to find solutions." This construction is not only what drives publics towards an issue or topic but also what guides how they feel about it. This again can be likened to DiSalvo describing the

[111] "the paper explores how design objects co-produce knowledge, by working through complex design problem spaces in non-reductive ways, proposing new connections and distinctions, and embodying design ideas and processes across time and minds." (Bardzell et al. 2015)

differences between strategy and tactic, drawing from de Certeau's *The Practice of Everyday Life* (Certeau and Rendall, 2011).

> strategies are expressions and structures of power exerted by institutions (broadly construed) that attempt to prescribe behaviour and courses of action. In contrast, tactics are means developed by people to circumvent or negotiate strategies towards their own objectives and desires. (DiSalvo, 2009, p.52)

The use of the word tactic therefore may include those external to the design domain as these tactics can be seen visible across disciplines. As DiSalvo writes, this may then extend who uses this knowledge; whether it be designers or otherwise. Articulation of ideas to audiences, according to Auger, can draw on many inspirations such as "observational comedy, psychology, horror films and illusion" (Auger, 2012, p.140). Borrowing from a lineage of aesthetics from other disciplines. Speculative design can also be seen taking inspiration of aesthetics from art (in use of the gallery space for example) and literature (in science-fiction for example) etc. The articulation of ideas (or tactics) using this lineage of aesthetics can therefore be seen to be offering a position. As DiSalvo describes it, this may be away from the mainstream or "beyond the common, often historically and professionally constrained, purposes of design" (DiSalvo, 2009, p.52). This may be the same case for why speculative design uses these tactics to deal with the previously constrained vision of the body seen in the anatomical body at the beginning of Chapter 3 (Body). These tactics may also take the body "beyond the common, often historically and professionally constrained, purposes of" (ibid.) anatomy[112].

5.1.3. Sfumato of Tactics

Gaver's paper on *Ambiguity as a Resource For Design* (Gaver, 2003) describes the intriguing smile of the Mona Lisa and the ambiguity that caused the success of the 77cm x 53cm painting. Gaver uses the technique of sfumato as a metaphor to explore the value of ambiguity in crafting design. Sfumato is a painting technique, merging colours together gradually with a dry brush to produce softness of form, seen in the corners of the Mona Lisa's mouth. "With insufficient information to go on, the viewer has to bring that smile into focus in their mind" (Gaver, 2003, p.236). The audience

[112] On Toby Kerridge's work Malpass (2012) writes "The project presents the idea that the tactics employed in critical design practice might act on the many issues surrounding bioengineering technologies and public engagement as an integrating and illuminating force by bringing different people together."

delineates the shape of the mouth themselves, therefore it becomes “terrain for infinite variations” (ibid.). Gaver (2003) likens sfumato to the softening of boundaries in speculative design. Like the sfumato of the Mona Lisa the speculative designer also crafts softer boundaries, causing the work to set the scene for the audience to internalise “meaning-making” (Sobchack, 2004). Bardzell et al. (2015) describes that for designers technologies are materials that are challenging to comprehend how to feel and judge. Speculative design[113] may help to work through or “clarify the contours” (Bardzell et al. 2015) of the design problem through exploration and thinking through. “Unpicking the different hopes, fears, promises, delusions, and nightmares of technological development and change” (Dunne and Raby, 2013, p.35) not only in the mind of the designer but in the mind of the audience. To make work which uses tactics that draw out feelings or makes the audience define their own lines (Gaver, 2013) may determine how we feel and judge provisional, intangible and speculative material.

Tactics are not independent, they interrelate and impact one another in sfumato. Malpass (2012) describes the relationship between rationality, satire and narrative in relation to speculative design and the results of the differing recipes of these ingredients[114], “as the object becomes less rational, there is a need for an extrinsic allegoric narrative.” For Auger (2013, p.14), it is exactly this interplay between these tactics which “guide the current of our emotions”[115]. Auger uses the term cognitive dissonance from social psychology. A term that describes “the feeling of psychological discomfort produced by the combined presence of two thoughts that do not follow from one another” (Festinger, 1962, p.3). It is not an inconsistency in thought but rather the predicament is created through an internal push and pull. “The viewer should experience a dilemma: is it serious or not? Real or not? For a critical design [and speculative design] to be successful viewers need to make up their own mind” (Dunne and Raby, 2013, p.40). It is the craftwork of blending tactics that sets this scene when encountering the work.

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[113] This is extrapolated from Bardzell’s topic of Research through design objects, but he speaks in reference to speculative design projects. Also speculative design artefacts being research through design objects are explored in Chapter 4 (Design).

[114] His thesis is mainly in relation to critical design practice but he also outlines differences between critical and speculative.

[115] Auger calls on Freud here and The Uncanny Valley.

5.2. Humour

Humour is a tactic frequently used in speculative design. Although Dunne and Raby argue that the type of humour used is important, for example parody[116] and pastiche are problematic as they guide the viewer too explicitly, not leaving any meaning-making for the audience. Satire, on the other hand (as above), converts them from being viewers to being questioners (Mollon and Gentes, 2014) "forcing a dilemma of interpretation within the user" (Malpass, 2012, p.225) as part of the exploration process happens in the mind of the audience. Dunne and Raby (2013) suggest that a sfumato of satire, irony, and more specifically deadpan, black humour and absurdity is what "helps resist streamlined thinking and instrumental logic that leads to passive acceptance; it is disruptive and appeals to the imagination." Satire is often considered to be an intelligent or high brow form of humour that uses wit and reason to expose or comment upon social problems often with the desire to inform or imply a change for the better. It is not necessarily for the purpose of laughter but rather to make the audience think by attacking particular behaviours or societal follies in a form of constructive social criticism.

> Design functioning in this way holds vices, abuses, and shortcomings found in orthodox product design, scientific developments or socio-cultural conditions up to ridicule. This is done with the intent of shaming individuals, the discipline and society into improvement. (Malpass, 2012, p.187)

Malpass positions the type of humour in speculative design works through both horatian and juvenilian satire, unlike critical design which works predominantly through juvenilian satire, and associative design which works predominantly through horatian satire (ibid.). According to Malpass;

> Juvenalian satire is often political quite savage and works through narrative techniques of antithesis, obscenity and violence. Horatian satire is less political and savage it identifies folly and works through paradoxical techniques of burlesque, colloquialism, exaggeration and anti-climax. (Malpass, 2012, p.187)

The difference in speculative design for Malpass is that it includes allegory, which promotes the satirical message for the audience. Retaining the satirical message through "use of physical realities and quotidian systems of use" (ibid.). The humour in speculative design might therefore be likened more generally to what Freud (1960) called "tendentious jokes." As they use controversial means to promote causes or

[116] Imitating the style of something or someone in an amusing way.

express points of view. Tendentious jokes (inclusive of satire) can often contain elements that are abrasive or aggressive[117] but are as Freud suggests are far more impactful and pleasurable on the audience than non-tendentious jokes, otherwise known as innocent jokes. Tendentious jokes "have sources of pleasure at their disposal to which innocent jokes have no access" (Freud, 1960, p.147). Like speculative design in comparison to other design specialisms, tendentious jokes often involve a wider context and more actors (occasionally including that of the joker themselves).

Misattribution of these jokes can be likened to the ambiguity mentioned above. Zillmann and Bryant (1980) coined misattribution of jokes (drawing on Freud's *Wit and Its Relation to the Unconscious*) to be similar to that of cognitive dissonance but in regard to humour. In that an audience may not be able to necessarily identify the core of what is humorous. Klein (2014) suggests that to have a sense of humour for design artefacts is to "recognize the ludicrous, or the incongruities…made apparent by designers." Satire therefore is not only a bridge as Malpass suggests between fiction and critique for speculative design but is also sfumato, it blurs the line between them so the audience has to define the line in their own mind.

Freud confirms Chaucer's adage that "many a true word is spoken in jest"[118] by suggesting that jokes are often an indicator of what is internally repressed. Although the tendentious jokes of speculative design may flirt with the fictional and the false, this may unearth underlying truths through the tactic of humour. Thompson (2010) argues that media culture is an outlet through which humour can deal with anxieties[119]. "Humour was widely recognised as an area where cultural anxieties could be safely expressed" (Thompson, 2010). Thompson refers to sick comedy as a particular genre that was a result of a time which had a preoccupation with mental health and psychosis in America. Thompson argues that it was a somewhat hopeless retort to cultural imprisonment of the current society's vision[120]. It was a way for individuals to make impact or comment more freely on larger systems which otherwise are a challenge to access, in the case of sick humour particularly regarding healthcare.

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[117] Freud (1960) mentions hostile ("serving the purpose of aggressiveness, satire, or defence") and obscene jokes ("serving the purpose of exposure") which may contain contents that are lustful or hostile.

[118] The modern version of "Ful often in game a sooth I have herd saye" (The Cook's Tale, 1390)

[119] His study here is specifically of postwar American television culture.

[120] Playing the jester.

> A joke will allow us to exploit something ridiculous in our enemy which we could not, on account of obstacles in the way, bring forward openly or consciously; once again, then, the joke will evade restrictions. (Freud, 1960, p.158)

Similarities may be seen in the speculative design movement in which dissatisfaction with current systems of design feel inaccessible to the individual designer, designing with insurmountable wicked problems. The adjunct speculative design therefore might be a way to use satiric methods to unearth the hidden and problematic elements of design as a way to encourage change[121]. Thompson uses an episode of the *Jack Paar show* (1958) as an example, in which Oscar Levant would make an appearance using satire to poke fun of his "precarious mental state" (The Jack Paar Tonight Show, 1958)[122]. His mental state being either real or a portrayed character was indistinguishable for audiences. The show would make fun of the exploitation of a mentally ill comic, putting into question the role of the media involved in this exposure. This show would aim to situate him as someone who was like the audience, dealing with the current mental health crisis, just as they were. "Individuals could then map their lives in respect to the ideological positions offered: Mad or well adjusted, hip or square" (Thompson, 2010). This projected empathetic mirroring[123],[124] is also a feature of speculative design as Auger (2013) says;

> The presence of the designed artefact in popular culture allows for the viewer to project its presence into his or her own life. Then they effectively become the protagonist in the story, playing out individual and informative roles. Their reactions become the true products of this form of design research[125]. (Auger, 2013, p.20)

In a collaboration with Dr. Kathryn Francis and Dr. Raluca Briazu, an exploration between two different forms of media (the printed word and virtual reality) showed

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[121] Dunne and Raby reference political comedians such as The Yes Men who use similar tactics, they reference "satire, shock tactics, caricature, hoaxes, fakery, spoofing, absurdity, and 'identity correction'" as a form of raising awareness of exploration of ordinary people by corporations and governments. Yet they suggest this is perhaps more sensational and "fits in a context of media activism, performance, and theatre" (Dunne and Raby, 2013, p.40).

[122] "for every pearl that comes out of his mouth a pill goes in" - from the jack parr tonight show (1958).

[123] Empathetic mirroring behaviour is a form of copying our imagining being in the place of another. It is often linked to children learning as they copy the behaviours of others in order to learn how to act themselves.

[124] Can be likened to method acting where someone will train themselves or act as someone else in order to imagine themselves as that character.

[125] Desmet (2004) calls this "interest product emotions" this is talked about in relation to products which continually offer stimulation of emotional arousal. These are things that encourage questioning or require further exploration. "the object of emotion is the product 'as such'" (Desmet, 2004, p.12).

different responses in participants exploring the same scenario (Francis et al. 2017). The vast tactics in production and aesthetics of these media forms have scope yet for exploration in this project, but through this collaboration I found that the nature of the format of media is explored through what psychologists call ecological validity[126]. Ecological validity is the extent to which findings of research relate to the circumstances, or context of the world that is being explored. The purpose of this term is to define how relevant a study is in relation to quotidian circumstance by considering the levels of verisimilitude of what participants experience. For speculative design aesthetic realism or sensory simulacra are methods not necessarily solely accountable for palpable verisimilitude. It is the sfumato between real and fake through the cognitive dissonance of humour and horror, anxiety and calm etc. that dictates to what varied extent a scenario may speak to the multiplicity of constructed publics. Sick comedy Levant's humorous scenario had heightened validity for, or in other words it successfully spoke to, a large but specific audience[127] using the tactic of humour and methods of the form of televisual media (the celebrity interview format) to be representative of a time in which atomic anxiety was at an all time high[128]. His questionably fictitious mental state broadcast to the public to show that they too could be this protagonist. They too had anxieties which had otherwise been brushed under the carpet. Although sick comedy "offered no remedies" (Thompson, 2010) the tactic of humour was the means to extract and bring to light those anxieties[129]. Just as the tactic of humour in speculative design can be used to expose the "complicated, contradictory and even neurotic" (Dunne and Raby, 2013, p.38) nature of people that Dunne and Raby say design often tries to hide. If sick comedy was built from atomic anxiety, could speculative design be a way to deal with bio-tech anxiety?

> "Doctor doctor I feel like a pair of curtains."
>
> "Well, pull yourself together."

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[126] Andrade (2018, p.498-499) internal, external and ecological validity in research design, conduct and evaluation. Also in research methods for the behavioural sciences.

[127] Those who could afford televisions, who were in the area where the show was broadcast, at a particular time in history, who had the taste for that style of comedy etc. in the case of sick comedy and this particular example this public seems particularly large for the specific nature of the humour.

[128] A topic dealt with in Dunne and Raby's huggable mushroom clouds.

[129] In relation to the collaboration mentioned above the tactic of humour or others may cause another response in participants. In the case of the VR scenario it has often been related to gaming (Francis et al, 2017) due to its relation to the familiar and accessible aesthetic of horror in digital game formats.

Humour in speculative projects can expose the absurdity and unexpected qualities of the extended body. Klein (2014) proposes that humour is often the result of the unexpected (she draws from Hutchinson, Kant and Schoepenhauer who suggest humour comes from an element of surprise). For example, in the familiar doctor doctor form joke above, the patient visits the doctor as they unsurprisingly feel absurd, the absurd and unexpected comes in the acceptance that the doctor too adheres to the patient's new form, and in trying to problem solve offers a solution which suits the form of their new imagined body. Speculative design arguably will always retain this element of surprise as it makes apparent things which are not yet visible. It acts like the doctor in the joke scenario by using the mundane and familiar as a foundation to then "provide spectacular, even preposterous, proposals with a tangible link to our contemporary sensibilities and understanding" (Auger, 2013, p.24). Auger here draws on observational comedy as a means to root speculations within familiar contexts[130]. This grounds the complex challenge of representing nascent technologies without being alienating due to technical detail or overly whimsical in representation (Auger, 2013).

[130] Although it is perhaps the relation to these familiar contexts which is responsible for Martins' criticism of speculative design as privileged. In using the familiar format of current technological aesthetics which is aimed often at the nuclear rather than the minority then speculative design in borrowing from this familiar aesthetic may also reflect signs of it. I do not believe this is a decision made in malice, but bias as these contexts may be familiar to some but not to others. To reiterate Martins (2014) it is the spreading and diversity that will extend these ideas towards a wider form of familiarity accessible to other publics.

fig.25: **Agi Haines (2013) Transfigurations**

In my project *Transfigurations* made in 2013, a series of five sculptures depicting surgical enhancements on newborns intentionally invites a variety of responses. The fictitious range of speculative transhuman procedures span believability, necessity and desirability in dealing with environmental challenges to come. The sculptures present surgical procedures for parents to consider as enhancements for their own children. In the wake of technologies leading to the "designer baby"[131] this project reveals that modification, particularly of children, is not new, and techniques today may achieve what we believe to only be alterations of the future. In presenting this project to the public, the order of the babies are curated to encourage a escalation of laughter and reflection. The laughter, seeming somewhat awkward from the position of speaker, is similar to misattribution of a tendentious joke. Speculating on this response which may result from a number of reasons. Firstly, there seems to be relief in the realisation that as the various procedures are announced it becomes increasingly clear that this project is not a suggestion in favour of the flippant and senseless mutilation of vulnerable members of society. Secondly, shifting the context of the design proposal using a

[131] Predominantly referring to genetic modification (Agar, 2006).

standardised design solution format in a deadpan fashion for violent and aggressive means increases the absurdity of what the audience is experiencing. Thirdly, the cognitive dissonance in bodily change for the sake of helping or harming is a troublesome sfumato to mentally draw a line between. Fourthly, the surgical propositions crescendo (on the third sculpture) towards a horrific procedure to extend the surface area of the cheeks so that the baby may better absorb caffeine and in the future work for longer hours, increasing its chance of wealth. An absurdity which always gets the biggest laugh (TedX Talks, 2014: 9:37), yet a frightfully frivolous proposal in light of those in need of health care, accessibility to food and wealth in a way that denies them access to decisions regarding procedures such as this. Then, after this discomforting absurdity, the final two babies are introduced; these proposals are considerably more grounded in familiar context as procedures for the benefit of healthcare issues, those being asthma and diabetes. Bringing the purpose, desire and hope for advancement back into focus. The humour here is far from facetious, the bell curve of laughter is what should hopefully bring the audience back to familiarity with new eyes, encouraging them to reconsider new technologies for their worth, their accessibility and their full complexities.

fig.26: **Hyphen Labs (n.d.)** ***NeuroSpeculative AfroFeminism***

Standing in a queue at Primer conference (2017)[132] I watched Ashley Baccus-Clark and Carmen Aguilar y Wedge apply and remove VR headsets from audience

[132] A Speculative Design conference in San Francisco.

members experiencing their *Neurospeculative Afrofeminism* VR film. Audience members often laughed or seemed joyous at a project making a significant and pointed statement regarding the underrepresented races and genders in technology. Unlike projecting yourself into the shoes of Levant, or imagining yourself as a parent in Transfigurations, in Hyphen-lab's experience you put on a VR headset and look into a mirror to see a woman of colour looking back at you. The unexpected absurdity of being another person might be responsible for the strange uncanny (Auger, 2013) humour, and although fantastical the audience quickly surrender to the familiar rituals of a salon experience. The VR experience introduces body altering speculative products such as hair extension neuro-implants and "sunblock for traveling through the multiverse" (Hyphen Labs, n.d.). All of their products are designed from the viewpoint of females of colour, critiquing current design for creating products and technologies that are not inclusive of these publics. For example, the sun lotion is clear, a comment on the white cream predominant in sun lotion currently on the market which is less suitable for darker skin tones. Although the work can be experienced without the VR environment (at primer festival they also presented images and objects) the humorous absurdity of this experience is a tactic that kick starts the focus towards more serious topics, and in doing so expands publics.

To master the craft or become a connoisseur of the tactic of humour, is to not undermine the problems it aims to address. Design may traditionally shy away from implementing this tactic to avoid putting the topics of design at risk of not being taken seriously. Not extending beyond the entertainment at a conference or performative element to an otherwise grave question[133]. The insights of sick comedy has shown that speculative design can also use tendentious humour, most specifically satire, to soften the boundaries of prickly topics. Design therefore does not have to be serious to reflect the seriousness of everyday life.

[133] "A danger for critical design is the possibility of ending up as a form of sophisticated design entertainment enjoyed more for its humor or novelty than its insights." (Erlhoff, M. and Marshall, T. 2008, p.96)

5.3. Irony

Irony is a term often referred to in regard to speculative design, yet rarely broken down to better comprehend its nuances. Blythe's (2016) *The Co-ordinates of Design Fiction* situates irony amongst extrapolation, ambiguity and magic. Blythe suggests magic and ambiguity are currently less explored than scientistic (work that is extrapolated from current research into the future) and ironic design. In his visual fantasy map showing the relation and location of irony, Blythe presents "the wide space of future undiscovered countries" or the possibilities for other tactics in this design work, suggesting that much work exists in the ironic area because it is fundamentally an easier position to take. As he draws on David Foster Wallace's "dominant" and "enfeebling" "constraints of irony." (1993). The problem with irony is that it can come across as "too simplistic and one linerish" (Dunne interview in Malpass, 2012, p.104) in its primary definition of "using language that normally signifies the opposite" (Oxford English Dictionary). This is often in verbal form and what Kirkwood (1958) calls "everyday irony." "The commonest type of all [irony], in which a person says one thing and quite consciously and without any intention of deceit means another" (Kirkwood, 1958). Ironic work that shows something as a way to promote the opposite (everyday irony) like parody allows less room for meaning-making. Other forms of irony may have differing implications to how work speaks to publics[134].

The attributes of irony may vary from intention to reception. For example, the *Transfigurations* project mentioned above may be read as ironic by seeing the visual evidence of a baby with a grotesque modification as an indicator to the audience that the technologies associated with this should not be in use. This project aims to present the complexity of decisions regarding this technology but shows the benefits as well as the negatives. Therefore, the project can be read as ironic when the audience brings into focus, in their own mind, the position that the technology is negative. In allowing room for meaning-making the designer succumbs to the fact that the mental line drawn by the audience may exist in different places and the tactic may have a different effect than expected, similar to Michael's *Engaging the Idiot* (2012) in Chapter 4 (Design). In returning to DiSalvo's description of a tactic as "designerly means for the identification and articulation of issues; such that they might be known enough to enable a public to

[134] DiSalvo (2012) describes irony as a trope which like tactics "are tools for crafting meaning" (DiSalvo, 2012, p.117) but tropes use symbolic rather than literal terms and structures.

form around them" (DiSalvo, 2009, p.60), to design work that encourages a scope of publics to form suggests the reception of the tactic varies. This draws from what Brigitta Zics (2008) calls "the artist-artwork-spectator interrelationship". Although she mainly refers to interactive art, the intervention she makes is important for this type of design work in which an intended range of responses means that the communication of the design work is often not solely to present a singular message, but rather presents the complexity of decisions in the spectators mind[135]. Zics' argument shows that art and in this case design objects, often involving and related to technologies, are not passive. The technologies in question encourage a flow between the artist and spectator that brings them closer together. Therefore the articulation of issues through tactics triggers a cognitive exchange of ideas between the designer and publics. Hence why the attributes of irony may vary from intention to reception, this is applicable to all tactics[136].

The irony of opposing or countering positions through objects can exist often in speculative design both in intention and reception, but there are other forms of irony which may also relate to the cognitive act of meaning-making seen in speculative design[137]. These different forms of irony are derived from dramas of Greek tragedy and unpacked here due to the storytelling nature of speculative design. Pfister and Halliday (1988) discern "irony in drama" as consisting of many forms of irony including directly opposing sentiments, or everyday irony, as above the primary definition used in critique of irony in speculative design[138]. The other form, which I believe is more often the attempt of speculative design work, is "dramatic irony" which is "when the internal and external communication systems interfere with each other and overlap" (Pfister and Halliday, 1991). This is when the awareness of an audience "adds an additional layer of meaning" (ibid.). A similar concept to the sharing in Zics' (2008) artist-artwork-spectator relationship in which all actors in this triad can add and change meaning

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[135] Similar to cognitive dissonance but cognitive dissonance is a challenge between two opposing thoughts. Zics' (2008) proposal is what is happening during and after, the reception of the ideas and the change in mind etc.

[136] Kirkwood (1958) in defining forms of irony refers back to the idea of subjectiveness of publics, in defining whether either Othello and Oedipus are ironic he concludes that this may be due partially to attachment of the audience to the characters and is dependant on interested spectators and how they perceive the play. As above this is also the case for art and design work.

[137] This is not including that allegory is arguably ironic in itself.

[138] As seen in Dunne and Raby, Malpass and Blythe.

throughout an experience. In a dramatic play, dramatic irony can refer to when a character is unaware of something that is made clear to the audience, or when multiple meanings suggest to the audience that there may be something to come beyond what the character expects. Sophoclean irony is another concept of dramatic irony in which actions are not in line with the audiences perception of the consequences. This dramatic and Sophoclean forms of irony seem clearly visible in speculative design. Where hidden layers encourages meaning-making and the audience can infer the consequences of the future.

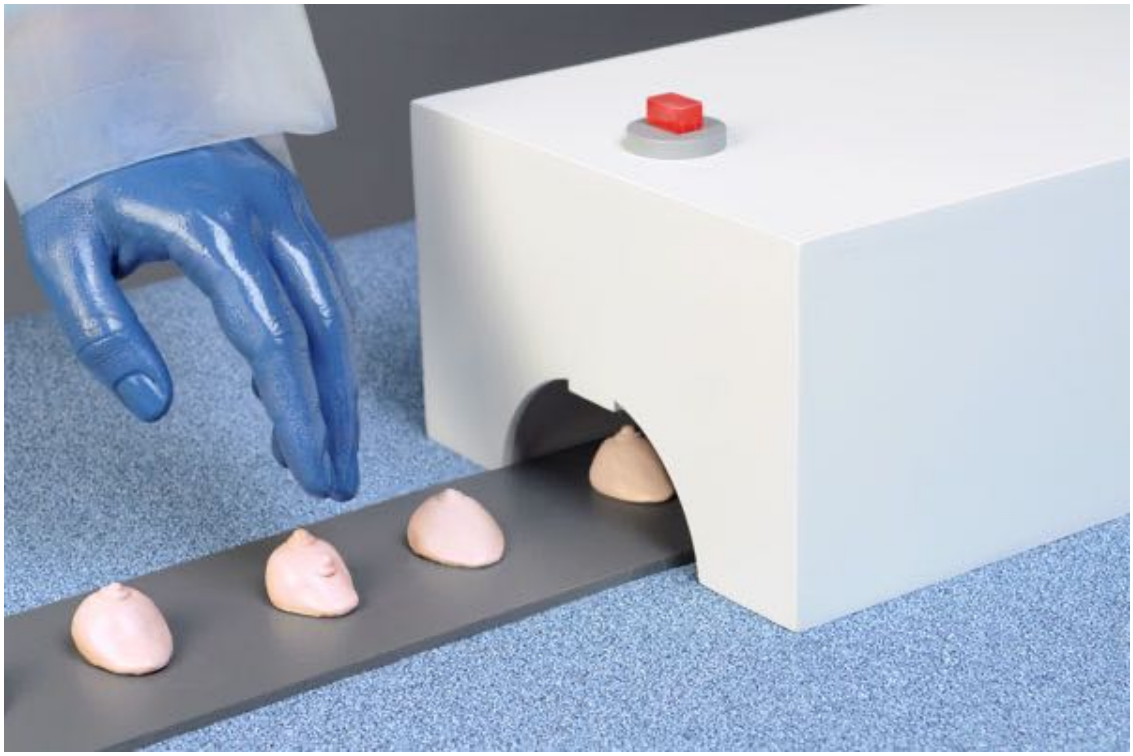

fig.27: **Emily Hayes (2012)** ***Manufacturing Monroe***

In Emily Hayes short stop animation film *Manufacturing Monroe* the audience observes factory workers "exploiting tissue engineering to grow and manufacture products that contain celebrity biopresence" (Emily Hayes, 2012). Factory workers push and pull cranks as a conveyor belt of Monroe's miniaturised breasts, that could have been developed from her breast stolen from her autopsy on August 5th, 1962 appear out of a machine. One worker is seen removing defected breasts from the belt and being called for lunch. On Blythe's map this project may sit across a few islands, it is scientistic in that it extrapolates a current scientific objective, tissue engineering. Showing scenes extrapolated from footage such as *Our Daily Bread* (2005) where factory workers throw defected or sexed chicks into massive vats and then are filmed on

breaks at work. It also sits on the land of the ironic but contains more elements of dramatic irony than everyday irony. As rather than showing that tissue engineering should not continue through a glimpse into its potential future, it adds layers that are visible to the audience for which those in this future may not be privy to or continue to live with. Firstly, that if this technology enters the consumer market it may promote the access of materials through exploitative means, stealing the materials and growing them on the black market for example. Secondly, it presents a future where although some technologies may flourish, others may not, as the workers follow familiar actions of current factory work. Thirdly, that the extended body through technologies such as tissue engineering could result in profiteering from the celebrity as a product in a troubling fashion. The factory workers may show elements of unconscious Sophoclean irony, in that the characters are acting in line with a truth which they know but the audience can see is otherwise problematic, or conscious Sophoclean irony in which they may know the truth but are reluctant to reveal it. Like other speculative design works regarding biotechnology *Manufacturing Monroe* may be one of the "cautionary tales that highlight what might happen if we carelessly introduce new technologies into society" (Dunne, 2008). These cautionary tales may be likened to tragic irony "that in which somebody is threatened by disaster" (Kirkwood, 1958). Tragic irony like dramatic irony is concerned with consequences but specifically those which lead to dire circumstances. Tragic irony may be misconstrued with everyday irony although is not straightforwardly oppositional it shows an array of problems that result from the circumstances at hand.

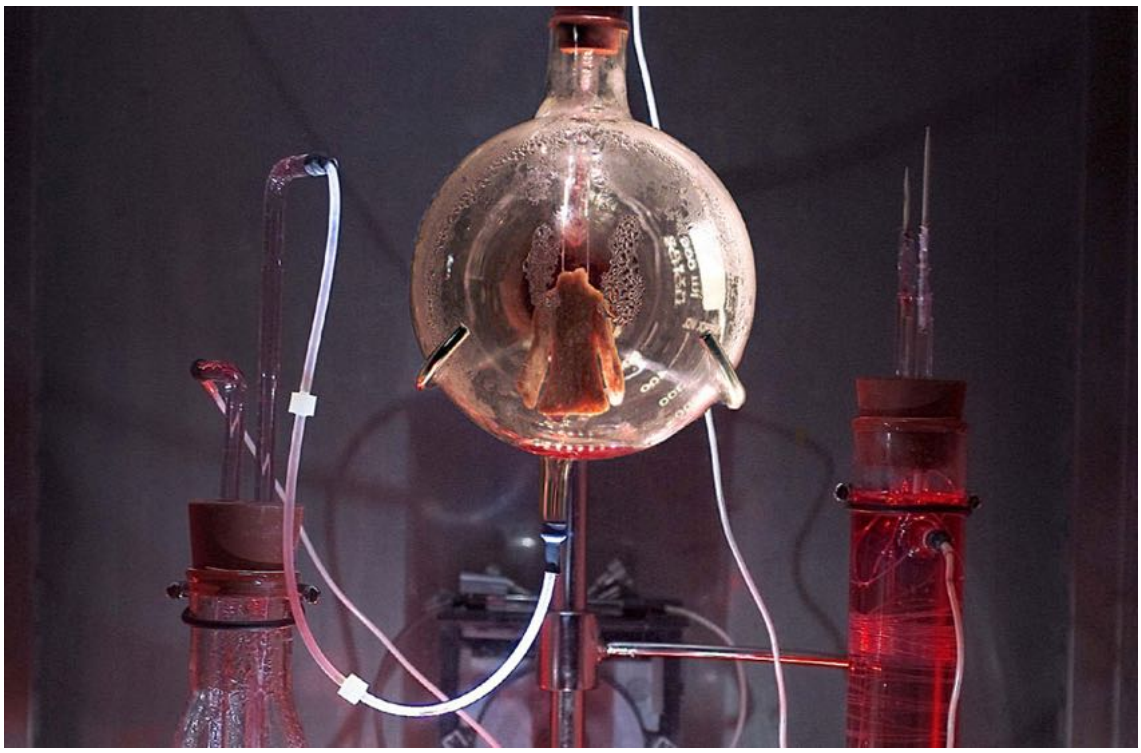

fig.28: **The Tissue Culture & Art Project (2004)** ***Victimless Leather***

Catts and Zurr's *Case for Contestable Design* (Catts and Zurr, 2016) proposes a form of design that involves being implicated or involved in the topics the designer is attempting to contest. Catts and Zurr promote "getting one's hands wet" (Zurr and Catts, 2003) by manipulating life on it's home turf[139].

> techniques, tools and methodologies are being used, subverted and elaborated on for the production of artistic knowledge, discourse and objects (which can be seen as contestable tangible items for cultural discussion, evocative objects or non-utilitarian artefacts). (Zurr and Catts, 2003)

Like everyday or verbal irony, the work is oppositional to the cause, yet the speculative element of the work is what affirms the complexities of dramatic and tragic irony. Through exposure to the disconcerting and delightful scope of what novel techniques and technologies may achieve, the audience is invited to consider the lineage of this work stretching into a future where the stuff of life is exposed to exploitative and capitalistic modifications[140]. Although the speculative element is not visually explicit in their work; *Victimless Leather* (2004) for example, the audience is left thinking if it is possible to grow a jacket now, then what product may be next, and perhaps they

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[139] In the lab and under its usual constraints set by scientific research. Usually at Symbiotica.

[140] Dixon (2008, p.671-692) also refers to how work like bioart which deals with "technologised nature" or "naturalised technology" can "illuminate how biotechnology offers us a way of thinking about the future, as well as the present and past."

themselves may be the future product, as speculated in *Manufacturing Monroe*. The audience adds a layer of meaning onto the work informed by what is before them. Irony in this case might be for the function Klein (2014) describes below.

> The purpose of irony is to awaken our capacity to see subtle contradictions in images and within language so that we may 'read between the lines,' and not take everything on its face value. (Klein, 2014)

Catts and Zurr's *in-vitro meat burger* for example, is often misconstrued as a motion towards the lab-grown burger[141] when on closer inspection a large number of calves were killed in order to grow a tiny portion of meat, exposing the harmful side effects of this kind of research. The thrilling prospect of witnessing a birthing, living and dying artwork in a gallery is at odds with the cognitive dissonance of the impending sense of catastrophe apparent in tragic irony.

> Discursive designers[142] can either perform the way a looking glass does - better magnifying, reflecting, and revealing aspects of culture for its audience - or they can act like a fun-house mirror - intentionally distorting in order to emphasise, propose, speculate, instigate, or criticize. (Tharp and Tharp, 2018 p. 13)

"irony can all too often be interpreted as cynicism especially in a discipline in which people expect solutions, functionality, and realism" (Dunne and Raby, 2013, p.40). Sole use of everyday or verbal irony can be unsuccessful tactics alone for speculative design (Blythe et. al, 2016). It is the multifaceted dimensions and multiple layers of dramatic or Sophoclean and tragic irony which is what leads to cognitive dissonance and successful meaning-making for publics. Kirkwood (1958) reiterates the description of Sophoclean irony by Sedgewick G.G (1948) as "the contradiction between 'is' and 'seems' in the working of destiny and circumstances." Speculative design that uses these forms of irony plays with familiarity (the is) and fiction (the seems), as Auger mentions above (Auger, 2012; Auger, 2013). This can bring to light the "never mentioned", "crafty and insidious aspects of the word 'design'" (Flusser and Cullars, 1995, p.53). Tactics such as irony in all its forms do not always leave the nature

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[141] Seen in 7news.com.au morning news segment, Vegan food: Now it's even easier to find plant-based meat alternatives.

[142] Discursive design as outlined in the locutions section in the introduction is an umbrella category that is inclusive of speculative design. "that includes more established and even quite esoteric versions that use design primarily as an intellectual communicative device. As such, discursive design is analogously a genus, with numerous species, each with similar intentions but with varying tools, techniques, postures, and audiences. The three most well' known species are critical design, speculative design, and design fiction." (Tharp and Tharp, 2018, p.552)

of design in a positive light, it can be exposed as being exploitative, destructive and unsustainable, building visions of dystopia. Although seeming cynical, often the overarching goal is one of positivity. According to Dunne and Raby (2013) speculative design unlike affirmative design, does not reinforce the status quo, instead it exposes representations that promote meaning-making leading to decisions about which futures are desirable. Upon reflection, design exposes signs of the time (Flusser and Cullars, 1995). In speculative design the use of irony is a purposeful play on the trajectory of current knowledge (its destiny and circumstances) to reveal the true state of things as they are now. Harnessing forms of expression like dramatic or Sophoclean and tragic irony can make these otherwise unmentioned aspects of design across time appear in the present[143].

5.4. Disgust

The reception of the two tactics above, humour and irony, predominantly result in a psychological engagement with the work, that being of cognitive dissonance and meaning-making happening in the mind of the audience member engaging with the work. The next two tactics have a stronger physiological impact in the body of the audience. In drawing on the action and experience perspectives on emotion, Gerald Cupchik (2004) might refer to the interactions between the mind and the body in reception of cognitive and emotional processes to design objects as "top-down" and "bottom-up" (Cupchik, 2004). The insights described above from humour and irony might be described as a "top-down" processes in which "feelings are the shadow of cognition" (Cupchik, 2004, p.4). In this case the mind is more dominant or precedes the body, this is when ideas dictate emotions. Processing the ideas and drawing a mental line then results in an emotional response to the work. "Bottom-up" processes are when "cognitions serve as a context for emotions" (Cupchik, 2004, p.5), in this case the body is more dominant or precedes the mind. The cue is a visceral response or gut reaction that triggers ideas or emotions (Fokkinga, Desmet, 2013).

> When the mind is dominant, then the body fanctions in terms of feelings, whereas when the body is dominant, it awakens the mind's eye with memories and symbolically meaningful experiences (Cupchik, 2004, p.5).

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[143] Like in Chapter 4 (Design) the successful use of these tactics would not be made possible without "looking behind the word and concept of design" (Flusser and Cullars, 1995, p.52) something which speculative design promotes, although of course not always successfully achieves.

Disgust can be an emotional response to a top-down process, just as humour and irony can be bottom-up. In this case the tactics of disgust and horror are discussed as predisposing a thought process or in their bottom-up form. In neurology the bottom-up response to the design stimulus might be thought of as a reflex, a sudden feeling of disgust and then consideration. Rather than a top-down contemplation, then a sensation of disgust.

In emotional studies of disgust Tybur et al. (2009) argues that there are three domains from which disgust originate. These three domains show the nuances of disgust for the benefit of measuring it, here they will be used to determine types of disgust tactics used. The three domains are

> …pathogen disgust, which motivates the avoidance of infectious microorganisms; sexual disgust, which motivates the avoidance of sexual partners and behaviors that would jeopardize one's long-term reproductive success; and moral disgust, which motivates the avoidance of social norm violators. (Tybur et al., 2009, p.103)

Below are projects ordered by these three distinct functional domains of disgust as bottom-up tactics, to trigger ideas exchange.

fig.29: **Christina Agapakis and Sissel Tolaas (2013) Selfmade**

Pathogen disgust was an integral tactic for *The Anatomy Lesson* outlined in the case study. The oozing eyeballs, soft fleshy silicone lungs and sticky blood covered

teeth were aesthetic means to induce pathogen disgust. Depicting the wet and soft side of future enhancement and body functioning away from the engineering and mechanistic analogies of Fritz Kahn (Debschitz et al., 2009). In Christina Agapakis and Sissel Tolaas's project *Selfmade* (2013)[144] the stark small white fridges containing brie, cheddar and other cheeses made from the toe and armpit bacteria of people including "food writer Michael Pollan, curator Hans Ulrich Obrist, cheese scientist Ben Dutton and artist Olafur Eliasson" (Synthetic Aesthetics 2014) is immediately gut-churningly repugnant. With apprehension audience members are invited to smell the olfactory profile of the bodily food. The pathogen disgust in this exhibit makes clear that "many of the stinkiest cheeses are hosts to species of bacteria closely related to the bacteria responsible for the characteristic smells of human armpits or feet" (Synthetic Aesthetics 2014). Yet in the configuration of food these bacteria are generally perceived as less disgusting, perhaps even delicious in comparison to when present on the bodies of others. This project becomes a series of "microbial sketches" or portraits of the hosts, the cheese sharing their "individual microbial landscape" (Selfmade, 2013). The work reveals the current vision of bacteria as discriminated by context. "It challenges simplistic, 'flattened' electronic analogies that we see in synthetic biology, but it does far more than this in its ambivalent disgustingness and potential edibility" (Calvert and Schyfter, 2017, p.210). This project promotes a tolerance of bodily bacteria and through the tactic of disgust suggests a move away from the sanitised representations of biological technologies.

The pathogen disgust here may develop from an adaptive drive to maintain the self (S. B. Miller, 2004), a sort of "'behavioural immune system' preventing contact with and ingestion of pathogens" (Tybur et al., 2009, p.105). *Family Whisky* is another food related project which successfully uses pathogen disgust in a similar manor to *Selfmade*. James Gilpin (Debatty, 2015) a designer with type one diabetes creates whiskey from the urine of diabetics which contains high levels of sugar. Like the cheese, the whiskey can have groups and flavours dictated by families genetics and eating habits. Art, design and technology critic and reviewer Regine Debatty writes "I wasn't as brave as other people and refuse to drink any of it" (Debatty, 2015). The

[144] Many Olfactory artists like Tolaas play with the tactic of disgust, some to prove that usual perceptions of disgust should be reconsidered in a form of everyday irony, and others to explore the sense of smell as medium to raise questions. A diverse range of these projects have been curated in talks and exhibitions as part of Mediamatic's Odorama series and research (Mediamatic, n.d.).

designers play with this tactic through sharing the materials of the body with the materials of food stuff, but also suggesting ingestion of body products associated with waste, fetidness and decay.

A similar disgust reaction is successfully achieved in Dunne and Raby's *Human Poo Energy Future Lunch Box* (2004), collecting faecal matter for energy use might make people reconsider bodily waste as a resource. Its close relation to food in the design, although appearing cleanly, is immediately disgusting in current context, but in the future it proposes perhaps it may no longer be considered disgusting. More directly; faecal matter is overtly displayed in Ginsberg and King's scatalog for their project *E.chromi* (2009), another work which puts value onto waste products. Much like Thought Collider's *Aqua Vita* (2012) project, in which real urine samples of the artists are exhibited to reinstate the information rich contents of urine for "metabolic profiling"[145]. The *E.chromi* scatalog on the other hand, presents a case of speculative faeces each containing pigmentation achieved through synthetically engineering bacteria ingested in yoghurt which would change colour on contact with disease, giving a colour indication of illness easily perceptible and readable from the toilet. This work is an extrapolation of collaborator's from Cambridge University who genetically engineered bacteria to "secrete a variety of coloured pigments, visible to the naked eye" (Ginsberg, 2009). This pathogenically disgusting briefcase of faecal matter once a "tool for critical discourse in synthetic biology…became a goal for synthetic biologists, with engineered probiotics now in testing" (ibid.) Like the *Human Poo Energy Future Lunch Box*, this possible disgusting future has become preferable.

The success of the pathogen disgust tactic in the projects mentioned above is that they make "body envelope violation" the breaching or altering of the normal body (Haidt et al., 1994, p.704)[146] relevant to new technologies, the analogies for which are usually clean and clear, like the construct of the anatomical body. Showing that the modern and technological body can also be disgusting, even though it may not have a history of being represented this way (Daston and Galison, 2007). As Calvert and

[145] Thought Collider (2012) metabolic profiling gives information about the person to whom the urine once belonged. Giving data about their health drawing from Traditional Chinese Medicine.

[146] This form of disgust according to Haidt et al. is separated from food and body products and often involves "gore, surgery, puncture wounds, deformity" (Haidt, et al., 1994, p.702) although may very dependant on personal variation so many categories share similarities and crossovers.

Schyfter write above the “ambivalent disgustingness” “does far more” (Calvert and Schyfter, 2017, p.210), it brings the body and traditions in affiliation with current technological research which disregards the messy and complex[147].

Tybur et al. (2009) argues that sexual disgust should be differentiated from pathogen disgust because the motivations for avoidance are distinct[148]. “Sexual disgust is an evolved solution to the adaptive problem of avoiding biologically costly mates and sexual behaviours” (Tybur et al., 2009, p.106)[149]. In a similar vein to the use of pathogen disgust to raise ideas and questions regarding the future perceptions of microbes and pathogens, these designers play with the boundaries of sexual disgust to raise ideas and questions regarding the future of romantic and sexual relationships.

[147] Synthetic biology a “new engineering approach to bioscience” (Ginsberg et al. 2014, p.ix) which adheres to the construct of the anatomical body explored in Chapter 3 (Body). Where “researchers reimagine bits of DNA code as programmable parts, analogous to the components of computer software and hardware.” Making biology “predictable and functional” (Ginsberg et al., 2014) through the design principles of standardisation. Putting the components of life on the production line makes it replicable and reliable in a way that reduces its price and increases its accessibility.

[148] With pathogen avoidance this is more universal, for example generally there is a benefit to the avoidance of those carrying a contagious pathogen whereas if someone may perceive another person as an unsuitable sexual partner this does not affect other relationships “e.g., nepotism, friendship, social exchange, or group membership” (Tybur et al., 2009).

[149] Like pathogen disgust in food for example the sexual disgust here does not cover the vast range of individual differences. Their main point is the drive to contribute to the production of healthy and viable offspring but also to avoid harmful and unwanted sexual relationship behaviours.

fig.30: **Charlotte Jarvis (2019)** ***In Posse.*** **Photographed by Miha Godec.**

In Posse (2019) a work by Charlotte Jarvis her mission is "to make 'female' sperm from my own stem cells" (In Posse, 2019). The work does not contain sexual disgust as this promotes healthy reproduction for same sex couples. Like the food and waste projects above it is pathogen disgust which aids meaning-making in this work. Although still a work in progress, an image of Jarvis holding a petri dish filled with fluid, like any other depiction of semen, is considered an "object likely to contain infectious agents" (Tybur et al., 2009, p.105). Once the gravitas of what this fluid represents sinks in, semen produced from female stem cells, the once disgusting liquid is awe inspiring in what this might mean for future romantic and sexual relationships. Like faecal energy, the body product is elevated.

fig.31: **Marta Giralt Dunjo (2017)** ***Visual X*** **(Dezeen, 2017)**

Marta Giralt Dunjo's project *Visual X* is a virtual reality game controller kit for "extreme sexual fantasies" (Dezeen, 2017). The three gameified pornographic controllers *Thuom, Suna and Avigan* are based on the "three orifices by which the UK Law defines the act of rape" (Dezeen, 2017). The discomforting nature of the work with its sleek technological artefact aesthetic draws on statistics from the normalisation of hardcore pornographic imagery. Questioning whether the increased use of VR in the porn industry may either help or aggravate the prevalence of sexually deviant behaviours in the real world. "The benefit this brings is instead of trying to legislate against actually creating something like her Visual X Kit, those on the other side of the discussion could feel as if they are being communicated with and not simply demonized" (Future Of Sex, 2017). A way to "create spaces for discussion" (Dunne and Raby, 2013, p.2) aimed towards those who have an inclination to otherwise remain silent. Visualising the extreme brings into question the impact and trajectory of this technology as it is currently increasingly introduced and woven into the fabric of the porn industry.

Both *In Posse* and *Visual X,* although with differing messages and differing uses of disgust, make visible the idea that technology is disruptive to the 'normal' baseline of the anatomical body seen in Chapter 3 (Body). *In Posse* meaning "before we are born" (In Posse, 2019) Jarvis writes that it refers to something which does not yet

exist but holds potential. Both projects show the exploration of technology as a potential to facilitate otherwise unobtainable goals, that of same sex born children or of rehabilitation. Using this work to probe the contours of enduring social norms. For Jarvis "We are striving for a form of technological, biological and creative activism" (In Posse, 2019) and for Giralt Dunjo what "could, and should be regulated?" (martagiralt, 2017). These projects may support what Martins (2014) calls for in a feminist approach in speculative design. Martins argues that technologies have been built "around a skeleton of complex hierarchies of power; it is the bone structure under the attractive and glossy skin of technology that feminist speculative design could expose, reflect upon and, hopefully alter" (Martins, 2014).

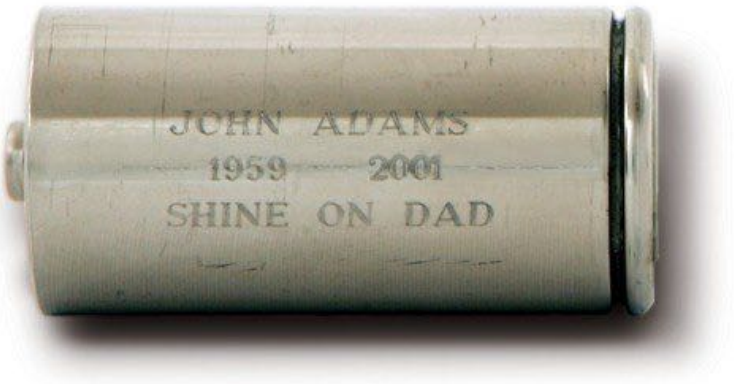

fig.32: **Auger Loizeau (2009)** ***Afterlife***

Another form of disgust is that related to standards of what Desmet (2004) calls "social product emotions." This is what Haidt et al. (1994) calls "socio-moral violations." Standards according to Desmet are beliefs of things we should do and expect. For example, people should brush their teeth or designers should create sustainable products. Standards embody core beliefs through which "moral and… judgemental evaluations are made" (Desmet, 2004, p.10). Some speculative design works play with the disgust born from anti-social beliefs which disturb standards. Although speculative design is not above judgement, it too is at odds with the standards

used to judge it. The projects *Selfmade* and *Family Whisky* above, for example, not only contain pathogen disgust but also the consumption of human products have long legally and morally been considered deviant and therefore socially disgusting. In *In Posse* and *Visual X* the work also questions beliefs that have legalities attached and also have historically been deemed deviant. In Auger Loizeau's *Afterlife* (2009) project, a coffin table is presented in which the decomposed deceased human body can recharge a battery using "microbial fuel cell technology" (Auger, 2012, p.151). The use of the body beyond death has long held social and legal rituals outlined in the human tissue act. Auger's reflection on the success of the first exhibition at "Design and the Elastic Mind" (2007) he writes

> Unfortunately the viewers chose mostly to ignore the intellectual aspect, focusing instead on the more unsavoury aspects of the project - namely tampering with the process of death, the passing of a loved one and the material activity of the human body during the operation of the fuel cell (decomposition). This resulted in simple repulsion as the benefits of the concept were overlooked. (Auger, 2012, p.152)

In order to shift the focus of the project away faster from this initial socio-moral disgust, which after the initial exhibit was too dominant in the take-away of the piece, the design duo ran a workshop in which people suggested uses for their Afterlife batteries (*fig.32*). This brings a personal touch which supports meaning-making, something which was initially challenging after the heavy use of bottom-up socio-moral disgust. The audience can then more successfully imagine how they might use a battery of their loved one or how they might want their own battery to be used. Adding this element to the work helped in "countering the initial repulsion factor and resulting in a form of desirable uncanny" (Auger, 2012, p.152).

> Because we cannot separate our view on products from our judgments of the people we associate them with, we apply our social standards and norms, and appraise products in terms of 'legitimacy.' Products that are appraised as legitimate elicit emotions like admiration, whereas those that are appraised as illegitimate elicit emotions like indignation. (Desmet, 2004, p.11)

Many speculative design projects use socio-moral disgust in order to encourage audiences to apply their own standards to the work through making judgements in meaning-making. The judgements are made on what Desmet (2004) calls "agents". The agent may be the object (product or design) itself, its maker (the designer, company or producer of the object) or its user. Speculative design adds a fourth agent to this as the agents are not only the speculative object, its speculative maker and speculative user,

there is also the designer of the project. In standard design processes the object may be praised because of its aesthetic qualities (eg. The Philippe Starck juice squeezer unlike any orange squeezer before it) or it may be reviled for its lack of functionality (eg. The new apple USB-C currently needing many adaptors in the face of apple's previous sleek modern designs). The maker may be praised for their originality or judged for lack of quality. The user may be praised for being associated with a positive product such as a fitness app or a negative one such as a gas guzzling car (Desmet, 2004). As above Speculative design may also be judged as being exclusive or raising questions without consideration. The connoisseurship of the tactic of disgust must involve an impactful meaning-making in the mind of the audience to legitimise the work so the audience can decide if they feel admiration or indignation and to which agent.

5.5. Horror

Linda Williams (1991) describes horror as one of the "body genres" in cinema due to its ability to provoke a bodily response. Referring to the latin horrere meaning to bristle, in reference to the tiny hairs erecting on the back of the neck when responding to the thrill of horror[150]. The sensory and somatic experiences of cinema for Williams (1991) and Sobchack (2004) are what links the body to the screen. Like bottom-up emotional processes Vivian Sobchack (2004) writes "movies provoke in us the 'carnal thoughts' that ground and inform more conscious analysis." Meaning is created through bodily sense. This representation of the horrific is a long accepted genre of cinema but is less visible in design history. "Dark, complex emotions are usually ignored in design" (Dunne and Raby, n.d.) but like cinema "In design, darkness creates a frisson that excites and challenges" (Dunne and Raby, 2013, p.38).

Noël Carroll (1990) differentiates "art-horror" from "natural-horror". Natural horror describes horror experienced in life, for example the horrors of war or horror at someone's action. Art-horror is an "emotion that horror narratives and images are designed to elicit from audiences" (Carroll, 1990, p.24). That is, "art-horror names the emotion that the creators of the genre have perennially sought to instil in their audiences" (Carroll, 1990, p.24). Art-horror refers to the tactic of horror used across

[150] she calls on James Twitchell the film critic regarding this.

different media forms[151]. In speculative design it is the horror that is fabricated by the designer. Carroll's definition of art-horror is predominantly "entity-based" (Schneider, S. J. and Shaw, D., 2003)[152] in that its focus is on the monstrous and impure beings of the horror genre. Carroll separates art-horror from art-dread. Art-horror is opaque in its visualisations, you see the monster assembled before you. Alternatively art-dread is "a disembodied, vague state of cosmic affairs" (Schneider, S. J. and Shaw, D., 2003) the horror is not always visible. Hills (2003) rather calls for an "event-based" definition. In event-based horror it is the narrative that sets the tone of impending horror; "the issue of whether a monstrous agency is at work remains open, since narrative events indicat[e] this may be imagined or coincidental" (Hills, 2003, p.146). Event-based horror can still include art-horror "fostered by cinematic devices other than plot that make monsters vivid in their scary repulsiveness" (ibid.).

fig.33: **Noam Toran (2011)** ***Après-Coup.*** **Photographed by Raphaelle Mueller.**

Après-Coup by Noam Toran (2011) explores the characteristics of event-based horror using art-horror. The exhibition reveals segments of a narrative "realised through

[151] Carroll specifies that not all horror that appears in art is art-horror. (When Carroll uses the term art he means across creative media.) Natural-horror can be felt in experiencing art, an example Carrol uses is the horror at the Avantgarde.

[152] Horror film has been anatomised into many genres and sub-genres such as gore, psychological, killer, monster, paranormal, zombie, vampire etc.

the disassembly and reconfiguration of a particular kind of cinematic vocabulary drawn from the psychological thriller and horror genres from the 40's through to the 80's" (williamsondesign, 2011). The work reveals recognisable tropes of horror in sculptures which have a familiarity, for example the abject (more below) and *The Monstrous Feminine* of Barbara Creed (1993) is visible in the bandaged figure of Rebecca (Toran, 2011) (*fig.33*). The tropes surfaced by Toran are an acknowledgement of horror by design in film, his horror vocabulary is "founded from a collective, cultural memory of film watching" (Toran, 2011). The tropes could exist as events in many different films but the sculptures expose aspects of cinematic devices used in art-horror.

fig.34: **Scale model of the Euthanasia Coaster. Julijonas Urbonas (2010)** ***Euthanasia Coaster.*** **Photographed by Aistė Valiūtė and Daumantas Plechavičius.**

Art-dread is a horror in which there is a sense of impending doom, differing from tragic-irony in which the doom is made clear to the audience inducing concern for things to come. In art-dread, doom is often experienced in tandem with the characters so the audience shares with them the fear of the unknown. For Freeland (2004) dread is not only less visible but is spread out along a wider timeline, horror can be a more immediate reaction but dread can be the result of anticipation, imminence and anxiety.

Euthanasia Coaster (2010) is a design for a rollercoaster by designer and previous theme park employee Julijonas Urbonas. The engineering feat would kill riders through an extended period of cerebral hypoxia[153]. The artwork consists of a scale model and an animated simulation of the ride. Unlike the ride based on the horror franchise *Saw* at Thorpe Park, UK, fabricating fear and thrill is undercut by the health and safety of a major theme park. Urbonas' "black humour prop" (Urbonas, 2010) designed in collaboration with a roller coaster engineer is unsettlingly horrific in the relation between the experience and impact on the rider's body. The scale model induces art-horror in seeing the twists and turns of this fateful thrill ride, but the speculative film of the rider induces art-dread as you await the rider's eventual demise. This is taken further as the systems which are currently in place regarding euthanasia are put into question and made unstable.

Deborah Dixon (2008) considers the horror of critical BioArt works through the entity of the monster[154]. Both Toran (Open Set Foundation, 2018) and Dixon (2008) refer to Derrida's definition of the monster as a dilemma, an un-categorisable other

> It provokes horror and wonder by virtue of its refusal to be confined within any categorical system other than its own and yet its imminent arrival allows space for the consideration of a host of new possibilities, of new modes of being and doing. (Dixon, 2008, p.672)

Toran explores the design of horror through engaging with otherness as it is expressed in film, through his film clip archive research "conversations with anarchists, birds, aliens, ghosts and the people next door." This unexplainable, un-categorisable monster might be likened to the as-of-yet uncategorised intangible, provisional and speculative body. For Julia Kristeva (1982) subjective horror is driven by abjection. Where sense of self and other become challengingly indefinable. The new form of the bio-tech-body "does not respect borders, positions or rules" (Kristeva, 1982, p.4) it is untethered by the conform of anatomy (seen in Chapter 3). It is "The in-between, the ambiguous, the composite" (Kristeva, 1982, p.4). The abject is seen in the many monsters of horror, an often definable trait of the genre (Carroll, 1990).

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[153] A lack of oxygen reaching the brain.

[154] Many of the projects of BioArt involve the monstrous by splicing and presenting the materials of life on a platter (sometimes quite literally as Dixon unpacks the work *Disembodied Cuisine* by Oron Catts and Ionat Zurr).

One of the most influential horror or science fiction[155] stories to speculative design being Mary Shelley's *The Modern Prometheus* (Shelley, 2008) for which Carroll (1990) acknowledges as the pioneering text of the horror genre. In which the extrapolation, as Blythe (2016) might situate it above, of technologies of the time such as galvanism result in the pathogenically disgusting body of horror, which like the abject, is one which "leaks wastes and fluids" (Kristeva, 1982, p.3). In the prefaces of the 1818 and 1831 editions Shelley comments on the scientistic nature of the tale[156].

> I shall not be supposed as according the remotest degree of serious faith to such an imagination; yet, in assuming it has the basis of a work of fancy, I have not considered myself as merely weaving a series of supernatural terrors. (Shelley, 2008)

Shelley's intention was to depict a character who through pure determination and innocence of seemingly virtuous progress created horror for himself. The art-horror in the description of the "hideous phantasm" (Shelley, 2008) although horrific in engendering the essence of this monstrous creature, the art-dread is what the character of Frankenstein shares most saliently with the audience. The dread is not only encompassed in the fear of an angry creature at large in the rural landscapes of Ingolstadt, Switzerland and Scotland, the creature is abject; its existence does not respect the "borders, positions or rules" (Kristeva, 1982, p.4) of biology, the body or technology. Dread is also made further evident in the protagonist's regret. Once faced with the creature, the implications of this feat come into sharp relief for Dr. Frankenstein causing him to flee.

Like Shelley's tale, in many speculative design projects the art-horror is used as a springboard for art-dread. In the project *Parasitic Prosthesis* (Haines, 2014) (appendix:Portfolio) I used art-horror tropes in the form of set dressing to represent a scene that might induce dread for an audience (*fig.folio50*). In exhibition *The Last Breath* (The Last Breath, 2014) at Clearlake Hotel, London, in a one night event; audience members were invited to enter the future domestic room of a person living in mutual relationship with genetically modified and morphologically bred parasites that can deliver hormones in their saliva. The leech-like creature replacing the prosthetic testicle of an orchiectomy patient could theoretically deliver testosterone to replace the

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[155] Carroll (1990) argues "science fiction is really a species of horror, substituting futuristic technologies for supernatural forces." (Carroll, 1990, p.14)

[156] Prefaces written by both Mary Shelley and her husband Percy Shelley.

function lost with the removal of this body part. The sculptures of the creatures share likeness with body horror, where there is a violation of the human form. With aesthetics inspired by David Cronenberg these sculptures bare resemblances to ideas in films like *The Brood* (1996) *The Fly* (1986) *Existenz* (1999) and more recently brought to life in retro fashion in *Stranger Things* (2016). Both the human and the creature in this installation are nature human hybrids only possible through the craft of technology (a form of Haraway's cyborg, 1984). One creature can be seen feeding from the sleeping patient's inner thigh, familiar to creatures like the face huggers of *Alien* (1979), the getting bugged scene in *The Matrix* (1999) or the bad eggs of *Buffy the Vampire Slayer* (Buffy The Vampire Slayer 1998). The other creature is in a glass case, visually similar to the cloning tubes, incubation tanks and stasis chambers of science fiction like the resurrection tank of *Star-Wars* (1977) or the Guild Navigator's tank in David Lynch's *Dune* (1984) often parodied in comedies like *Rick and Morty* (2013). The bedroom is dimly lit like the bedrooms of *The Exorcist* (1973), *The Babadook* (2014), *Nosferatu* (1922) or *Paranormal Activity* (2009). From these visual references it is clear the communication of the work fits amongst a rhetoric of science-fiction-horror set design. Although the art-horror is visible, like *The Modern Prometheus,* the enduring message is one of dread. The implications of this technology are seen entering the market and being domesticated. To observe the horror of Cronenberg mediated by a screen and experience the rising hair on the back of the neck is Sobchack's (2004) "vision in the flesh,"[157] imaging this living prosthetic also induces a somatic experience. To wake up in the night plagued by thoughts of the art-horror becomes dread, just like imagining extending the fiction beyond the sculpture into the future home.

The extrapolations of speculative design may breach the borders of art-dread into natural-dread, as audiences picture the trajectory of the future technology.

> Design is assumed only to make things nice; it is as if all designers have taken an unspoken Hippocratic oath to never make anything ugly or think a negative thought. This limits and prevents designers from fully engaging with and designing for the complexities of human nature, which of course is not always nice. (Dunne and Raby, 2013, p.38)

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[157] Sobchack (2004) writes about how a sensation in her fingers show the recognition of shapes on the screen before her brain did, as she felt a sensation in her hand before she was completely aware of what she was looking at.

The inclusion of art-horror may help break this vision of design as Freeland (2004) states in regard to films with art-horror "they help us ponder and respond emotionally to natural and deep worries about the nature of the world."

> it is not the irresolute figure of the monster itself that is of significance, but rather the individual's willingness to recognise the existence of that which lies outside of ready understanding, as well the manner in which the struggle to accommodate such a figure disturbs our imaginings of our own place in the world. (Dixon, 2008, p.672)

In attempting to situate the bio-tech-body's place in the world it becomes monstrous. In relation to speculative design, this may describe why the making and production of the work is lesser the focus than the content. In the case of horror, the art-horror or the fabrication of the monster, particularly when it is synthesised rather than made using the dynamic tissues of bio-art[158], is less horrific than the concept of its implications. Art-dread is the predominant goal of speculative design, to leave an imprint on the audience for which they might mentally return to later, beyond the gallery/lecture/workshop/ performance etc. It is the cognitive-dissonance of attempting to accommodate the monstrous future into quotidian life.

> Safe ideas will not linger in people's minds or challenge prevailing views but if it is too weird, it will be dismissed as art, and if too normal, it will be effortlessly assimilated. If it is labeled as art it is easier to deal with but if it remains design, it is more disturbing; it suggests that the everyday life as we know it could be different, that things could change. (Dunne and Raby, 2013, p.43)

This is why the design tactic of horror is an appropriate vehicle for communicating the grapple with the new, as historically design has been responsible for the assimilation of new things into the lives of everyday people. Hence why the art-dread of speculative design is often perceived to be dystopic (Martins, 2014). For Dixon (2008, p.671) "the future is necessarily monstrous" otherwise it would be "predicatable, callable and programmable." In many cases then, even when art-horror is not a tactic, the future may be considered horrific as it contains the unknown. It is dread formed of a Frankensteinian regret for something which has not happened yet. That the audience may not want to take the path that leads to the creation or endorsement of this horrific result.

The mea culpa of designers is often resultant of their role as gateway of communication or assimilation of an idea to a public. These works suggest there is still

[158] Often referred to as creating monsters - particularly in relation to Catts and Zurr.

time for change as long as there is room made for self-reflection before "midwife[ing] a design into its existence in the world" (Nelson and Stolterman, 2012, p.175) (as above).

> His success would terrify the artist; he would rush away from his odious handiwork, horror-stricken. He would hope that, left to itself, the slight spark of life which he had communicated would fade; that this thing, which had received such imperfect animation, would subside into dead matter; and he might sleep in the belief that the silence of the grave would quench for ever the transient existence of the hideous corpse which he had looked upon as the cradle of life. (Shelley, 1818)

Unlike humour which aims to unearth cultural anxieties, art-horror may embody them. According to Carroll (1990, p.213) the tropes of horror "address an uncertainty about living in the contemporary world which is made more urgent since…there is a belief that there was a time, not so long ago, when things seemed stable and a sense of certainty prevailed." Horror articulates anxieties "founded on the disturbance of cultural norms, both conceptual and moral" (Carroll, 1990, p.214). Art-horror may solely articulate the otherwise unseen, for the curious, the thrill seeker or the perverse. It may also reveal monsters at the intersection of the body, monstrums "that which is worthy of warning" (Dixon, 2008, p.679) and most explicitly the designs present monstratums in that they "point to that which is worthy of warning" (ibid.).

5.6. Design tactics: a resource for communicating the body

5.6.1. Conclusion

Above are four tactics used in speculative design; humour, irony, disgust and horror. Each tactic has been outlined in a loose anatomisation using cuts and delineations borrowed from other disciplines. These segmentations have been selected for their relevance to design to find ways design can access or communicate the future body. Examples of particular projects have been given which draw design and the body ever closer in conversation with one another. These four tactics and the examples given are in no way demonstrative of an exhaustive analysis, they are select examples and there are infinitely many more. These tactics and examples of such are of particular interest as they firstly relate to insights gained in *The Anatomy Lesson* case study but also they lend themselves to dealing with the materials of the bio-tech-body as it surrenders itself to provisionality, intangibility and speculation. They have been articulated in this fashion firstly to encourage a designerly language (Cross, 1982)

specific to speculative design. Not to form new terms but to express how new models of design do not necessarily have fixed moorings and if designers continue to take reference from other disciplines how might design successfully take ownership of its angle on these terms. Secondly, the cuts of this anatomisation, although borrowed, represent the ways to better understand the tissues of the construct of design as seen through the lens directed towards the future of the body.

In order to develop connoisseurship (described above by Nelson and Stolterman, 2012) of tactics, a designer must make appropriate decisions regarding the recipes of tactics used so the work may successfully tackle the topic at hand as well as speak to appropriate publics. The anatomisation and examples of tactics above are for designers to further comprehend aspects of their flavour. As well as how publics can engage and respond to design work that embodies elements of these tactics so they may be cognisant of how these tactics interplay with reception of a design work. These decisions are what might be considered as ‘gut instinct’ or ‘working viscerally’ they are not decisions based on rules of logic, they are what Nelson and Stolterman (2012) would call “design judgements.”

> Design judgment making is the ability to gain subconscious insights that have been abstracted from experiences and reflections, informed by situations that are complex, indeterminate, indefinable, and paradoxical. This results in the emergence of meaning and value, through the creation of relationships and connections that cause the appearance of unities, forms, patterns, and compositions, out of apparent chaos. (Nelson and Stolterman, 2012, p.139-159)

Design judgements are decisions or understandings that occur not through measurement or by following rules or a strategic technique but rather they are the basis of the derived axiom that designers create using a form of intuitive logic. This is developed from a mental portfolio of references and from “accumulation of the experience of consequences from choices made in complex situations” (ibid.). For Nelson and Stolterman (2012) “judgement is knowing based on knowledge that is inseparable from the knower.” For an audience, judgement happens internally. For a designer, judgement often has to be outward looking, it has to consider the impact of tactics on publics. This chapter of the thesis aims to consider the nuances of tactics that bring design and the body closer together through engaging with publics. For the work to be successfully humorous, ironic, disgusting or horrific for a public, the designer has to make suitable judgement of which ingredients to choose and in what measure. This is a challenge as

the designer is also a person whose knowledge is inseparable from the knower and regardless of connoisseurship, judgements are often erroneous and therefore communication can be problematic[159]. As work can be suited to their sensibilities or unique past, taste and knowledge which can exclude or have unintended effects on differing publics[160].

Then how have these tactics supported the goals outlined at the beginning of this chapter "to explore the expressive or functional capabilities of a new material… to help a designer creatively explore a problem domain" (Bardzell et al., 2015)? As the materials of this new body become ever changing with the growth, degradation and decay of the provisional, scattered across the data points of the intangible, and extrapolated and imagined in the speculative, they become the abstract materials that Nelson and Stolterman describe (2012). It seems it is tactics such as those above that gives the materials of the provisional, intangible and speculative body dimensional flesh for an audience. It is no longer the unknown material of an unfathomable future, it is brought closer to comprehensible and familiar terms, using territory with recognisable features. Its materials can be anxious, tragic and even smelly. The new body is definitely "a problem domain" (Bardzell et al., 2015), it is monstrous, or in other words, it is a challenging dilemma, but it can have discernible traits[161] that allow the "expressive or functional capabilities" (Bardzell et al., 2015) of this otherwise inaccessible body to be explored. These tactics, when used with appropriate design judgement to make design outcomes, make the new material and problem domain of the future body "appear and be experienced in a real sense" (Nelson and Stolterman, 2012, p.175) (as above). They facilitate ways in which to make the speculative and ever changing nature of complex materials communicable.

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[159] In a collaboration with IDEO the description of the work from both myself and IDEO expressed the project in a different light, this may be a result of members of the collaboration attempting to reach a slightly different public, or that the wording alongside the work presents a slightly alternate angle on the piece.

[160] For example I fear that when approaching a healthcare issue such as diabetes, a diabetic public may take offence or not see the work in the same light as a non-diabetic public. This is when a collaborative judgement is an invaluable asset to make these decisions, even if judgements of collaborators are also based on individual experiences, it still extends the scope of judgement beyond personal experience.

[161] This is not to say that these traits are necessarily truthful or correct but they make this body more concrete / corporeal so it is a solid platform to explore.

6. CONCLUSION

The following conclusion reiterates the main points covered in this thesis in an overview of its contributions to knowledge. These are ordered by subject rather than chronologically. It considers the value and relevance of the findings in support of design as an instrument of knowing the body. It also evaluates the methodology and limitations of the approach and then speculates on the future of speculation, suggesting further scope for research and potential for ideas exchange.

6.1. Contributions to knowledge

To describe the insights gained during this thesis I have split these into topics which collectively construct the arguments in each chapter of this thesis. The overarching argument being that speculative design is a model of design that is valuable for exploring the body because it highlights processes of design that are intrinsically and intimately linked with the processes of the body. As outlined in this thesis, speculative design and other contemporary models of design that share characteristics, named in the introduction, are often described as being discursive (Tharp and Tharp, 2018) or creating discussion (Dunne and Raby, 2013) that engages publics (DiSalvo, 2009). Little focus is put on the psychological and physiological affects associated with the cognitive processes of imagination that reside in the body, and are inherently involved in speculation. This thesis attempts to set up a connection which will allow for further exploration of the intimate connection between the models of speculative design and the models of the body. As mentioned in the introduction; to set up this connection this thesis creates links between design and the body in the way they have been dealt with as subjects of study, and in the way they are understood in mental models. Also, in ways that design has attempted to engage with models of the body by creating artefacts that encourage publics to reevaluate the body through experiences in their own bodies (comedy, irony, disgust and horror).

“[T]he systems that shape the poem are indistinguishable from those that shape the poet” (Punt and Denham, 2017). Designs come from the human body, shape how we understand the body and in turn shape the human body itself. Similar to Punt and Denham’s quote above, the design work described in this thesis is the result of idea exchanges which shape both the work outputs (the practice) and those making the outputs (the designer). The work can then be used as conductors for intentionally facilitating ideas exchange and, in this case, can shape the mental models of those experiencing them, collaborators and audiences (publics).

This thesis outlines a short history of momentous engagements between design and the body that have occurred through paradigm shifts, and how both the body and design have experienced a somewhat mirrored process of anatomisation. It also describes how speculative design can open up or make models that may need reevaluation visible through exposing the frictions in current models to the public or to collaborators. It also considers trajectories and brings to light impacts on society should certain mental models remain or new ones appear. Finally, the tactics associated with speculative design are linked to exchanges that promote bodily processes and reactions, that being comedy, irony, disgust and horror. The sfmato of these tactics are what can instigate ideas exchange of particular topics and concerns. Tactics can communicate the frictions with mental models that already exist, and if this results in what Punt and Denham call cognitive innovation, may even change those mental models.

6.1.1. Using references through the lens of design

Chapter 3 (Body) follows three paradigm shifts in modelling the body; from the enlightenment to present times, through the lens of design. Considering modelling as a design process. Due to design being a younger discipline than that of anatomy and art it is often left out of the discussions regarding imaging, performing and creating body models prior to the contemporary surge of biotechnology and its impact on “designing life” (for example synthetic biology and the work of Craig Venter) (Ginsberg, 2014). Creating links between the history of body modelling and design processes may give design some authority when dealing with contemporary models of the body which can then draw from a heritage of analogous practices. This suggests the current collective body model has been designed through a process which mirrors design methods; creating, establishing and advancing the body model over time.

6.1.2. Speculative design as adjunct

Design specialisms, such as speculative design, mentioned in the introduction (1.4.) which have tendencies towards provisionality, intangibility and speculation could be considered adjunct specialisms. Considering speculative design as adjunct has a number of benefits; in that, not only may it relieve the complex and somewhat distracting focus on the nomenclature of this discipline, it may also allow this form of design to spread more into other unknown places and engage with new publics. This means it may not be anatomised further at this vulnerable stage in which elements may be lost if it continues to be cut and made concrete through territorialisation of its parts. This may also allow it to shift beyond its original locutionary heritage, retaining the relevance of its valuable insights if it is given the space to change. Thinking of speculative design as an adjunct may on the one hand encourage it to be taken up by commercial design, an arena originally in contrast with the ethos of speculative design and therefore become less concentrate. Although to consider it as adjunct might mean that its combination recipes, along with other forms of design, changes its model slightly, meaning that the commercial or capitalistic uses of this term might be seen as a different model rather than a full embodiment of its original ethos. As its uses get increasingly established in these areas its models might be easier to delineate and therefore anatomise as I imagine is eventually inevitable.

Speculative design as an adjunct may also mean it is celebrated as more of a hybrid practice, giving these forms of design more opportunities to work within transdisciplinary settings. As it may be considered a link or membrane between complex models of disciplines, in the case of this thesis of design and the body.

6.1.3. Designing models of bodies not bodies themselves

Another contribution that this thesis makes is that it differentiates between proposals and provocations of the future body by suggesting that the adjunct of speculative design does not attempt to redesign things immediately in the real world. Instead, it attempts to instigate change (Dunne and Raby, 2013) by redesigning the models and allowing, in turn, those models shape how things in the real world are understood.

This also supports the distinction between speculative design being involved in redesigning the materials of the body as a transhumanist might, and speculative design being involved in redesigning models of the bio-tech-body which is indirect and instead is about designing models, not things themselves. This suggests that the making of an artefact does not legitimise the ideas as proposals or propositions. This is made particularly clear through the diegetic prototypes of speculative design which exist in a world (or diegesis) in which the provocations are normative, as a means to suggest they are fictive. This is where speculative design shares its borders with bioart. Although bioart engages with living or semi-living materials the intentions are not always to promote this material as a site of change, instead they also use these outputs as means to manipulate mental model making.

This is to somewhat subvert discussions regarding the analysis of measuring change. Making work that instigates change is a broad statement which I have not felt brave enough to make of my own work. Instead I feel the work is in support of change and promotes change to wide audiences; whether that change occurs in direct relation to the work is a claim I feel is somewhat impossible to make. Instead this thesis focuses on changes that happen in the body of those engaging with the designers and their work, changes in mental models or how things are understood through sharing ideas.

6.1.4. The body and design are more provisional, intangible and speculative

The body and design are in conversation because they are currently sharing a notable shift, from static references towards dynamic references. They are both being understood through models which are provisional, in relation to time, intangible in relation to contextual matter and speculative in relation to imaginaries. The models of the body and the models of design are now converging at a point in which challenging and complex subjects or “wicked problems" (Rittell, 1972) are having to be tackled. The provisional, intangible and speculative nature of new models of design might be a route to finding ways to reconsider these problems. Through using tactics which do not lose the nuances of the complexities associated with those problems. As Paola Antonelli (Eyeo Festival, 2018) says “in order to have consequence on a world that sometimes seems like to have lost its compass, designers and architects have to be brutal or disquieting, pose hard questions and tackle unpleasant subjects in uncomfortable ways.” The provisional, intangible and speculative nature of design and the body may at first be

a discomforting notion as it involves moving away from orthodox practices. Design particularly can benefit from this move as it may be considered a way to seriously engage with the body and in that way design can redesign itself away from being a discipline in the service of other disciplines, and rather become more intellectually autonomous.

6.1.5. Speculative designerly language

Design has no fixed mooring, in that design is a discipline which regularly takes influence and in turn terminology from other disciplines. In order to take ownership of the language entering speculative design territory the terms need to be explored through the lens of speculative design. Regardless of whether the terms originated in another disciplinary camp, if brought across the membrane towards design, more work needs to be done on refining the nuances of new design terminology. This is also argued by Malpass (2012) regarding terms such as function and irony. It is of course somewhat ironic that I make a case for ownership of terminology whilst deciding to not anatomise speculative design any further. A distinction here has to be made regarding where finite versus loose terminology is helpful. As discussed in this thesis, clear terms can be helpful to communicate transdisciplinarily. Although intra-disciplinarily terms need not be rigid but their nuances must be understood. As this thesis speaks predominantly to designers nuances of terms are particularly important but not their borders.

As Punt and Denham write; the vocabularies that arose through the ideas exchange amongst CogNovo “while not claiming any privileged access to truth, can be played off creatively against other vocabularies” (Punt and Denham, 2017). These terms shared across disciplines can then be understood for their worth toward specific agendas. The same case is made here in which the strategies in Chapter 5 (Body - Design) can be drawn more towards the intentions of the designer but also that in using these terms, speculative design may be drawn more towards other disciplines.

6.2. Evaluation of Methods

This segment predominantly makes reference to the methods section (1.3.) in the introduction. The methods section describes a more exhaustive description of the practice based and theoretical based methodology and its reasoning. This thesis does not

dwell on the pathologies of speculative aspects of the design discipline. This is of course in no way suggesting that there are not issues with these methods or that there are not projects that are problematic nor is this apathetic to the insights gained from the pathological research. Rather, it aims to bring elements that work successfully into the forefront so that those engaging with speculative design may be influenced by their affects.

> The critic is not the one who debunks, but the one who assembles. The critic is not the one who lifts the rugs from under the feet of the naïve believers, but the one who offers the participant arenas in which to gather. (Latour, 2004, pp.246)

For design to commandeer another disciplinary term from theatre, what Latour (2004) describes is very much a *yes and…* approach. *Yes and…* implies that no insight is unhelpful, just some are more helpful than others. This is something that was learnt quickly whilst working within the CogNovo course and with external collaborators, as there are multiple voices and each with a startlingly different vocabulary to navigate. As it took time to start to find a shared language it became possible to exchange ideas and in that time the significant threads arose. *Yes and…* in a similar vein to what Latour (2004) describes, flies against orthodox research which was established by heroes of arts and sciences such as Vesalius in Chapter 3 (Body), in which to build up an argument or an idea, another has to be disproved or taken down. A return to Kuhn's description of normal science (Kuhn, 1970) which shows that science moves in revolutions and when in a paradigm ideas are more challenging to shift. This approach reveals an aim in the theoretical methodology which was to show that novel and therefore vulnerable ideas are often more likely targets. Keeping a somewhat amorphous anatomical structure might permit this model of design to be open to change rather than dismissive of it.

Yes and… is a term used in improvisation which allows actors to be open to the contributions of others in ways that enhances fluidity and lubrication of conversation. Without shutting down ideas or voices prematurely before ideas exchange is allowed to take place. This is where the idea for speculative design as adjunct arose. Whilst speculative design is still fragile anatomically it should not be preemptively cut without consideration of where it might lead, as cutting can sever ties to arenas not yet made. This may be problematic in that it does not fully cover the issues which are pertinent in this adjunct of design. My decision to do so was to pull aspects to the forefront which

may be more beneficial to those involved in the practice of design or those wanting to engage with design practitioners. As Matt Ward writes about criticism of speculative design;

> I think the best way to critique is through evolving alternatives. Most of the critics are academics that teach. If someone has a problem with the approach, teach it in a different way. (Speculativeedu, 2020)

Therefore progressing the aspects of the work that can be built on (*yes and…*) rather than focusing continued efforts of pertinent researchers and practitioners onto the elements which might lead to dead end threads[162].

That being said, there are a few discontents of speculative design which are not fleshed out fully in this thesis. These discontents in particular suggest ways to move forward in this research and require further attention. The first returned to throughout but particularly mentioned in Chapter 5 (Body - Design) was Martins (2014) proposal towards a feminist speculative design. Martins' practice-based work builds on this and the overarching argument is encouraging more speculative design works to include voices from underrepresented publics. More work needs to be done on the spread of this adjunct and how it might, on the one hand act as a pedagogical tool internationally to teach elements of design (Speculativeedu, 2020) and on the other how it can shift, becoming a useful resource for different needs and environments. Inviting alternative audiences through the accumulation of diverse publics. Its adjunct form might be more supportive of this rather than trying to fit into the original purposes of its conception. As ultimately adjuncts reshape the configuration of design. An adjunct model may therefore also move away from their locutionary heritage, meaning it can move on and develop in ways disassociated from its founders.

Another criticism of speculative design which is not explored in this thesis but mentioned briefly above in this conclusion is the query of how to capture, collate and evaluate the change which speculative design promotes. As models most often proliferate through the minds of audiences, the effect of this form of ideas exchange is difficult to gauge than in other forms of design which can track usage, audience numbers or selling rates far more clearly. To measure how ideas are being spread can

[162] As I have been teaching during the writing of this thesis I definitely have to agree with Ward's insights in Speculativeedu (2020). I teach a range of arguments on this topics in talks on theory but in practice I imagine most tutors bring forward the elements which they believe will most likely enhance the student's design work.

only currently be gauged through proliferation in publication such as academic outputs, exhibitions and events. Whether those events lead to long term effect of ideas exchange is difficult to measure. One downfall of my practice-based methods was that I could have better tried to capture responses to the works. For *The Anatomy Lesson,* for example, I made clipboards with questions for audience members to fill in, but quickly discovered that this took focus away from the performance of the work and one-on-one engagement with people. As the first group who attended were reading their clipboards rather than engaging in the experience or not bothering to fill them in once the performance was over as they wanted to leave. Also, and more practically in relation to the logistics of the event giving the audience members pieces of paper was incredibly difficult to manage whilst also interacting with slimy and sticky materials. Many of the responses to the work happened fluidly in conversation whilst the dissection was occurring. For example, audience members began sharing often incredibly personal stories of operations, which was a response I was not expecting. An element of overspilling described in Chapter 4 (Design). After my collaboration with Francis and Briazu, it also became clear that questionnaires are in no way a successful means of capturing long form discussion or real concrete evidence of instigating change. This is due to issues of capturing the veracity of answers in such a format like a pen and paper questionnaire with low ecological validity (Francis et al., 2017). The hope in many cases, that speculative design may instigate change occurs not directly in the world with immediacy but rather through its imaginative instigation which may change mental models which eventually have impact as those models dictate how, in this case, the body is perceived and dealt with.

The thesis also suggests that traditional forms of data collection may in fact be counter productive to the thinking in speculative design, particularly that of engagement events which inspire overspilling or proactive idiocy (Michael, 2012). This is also as speculative design may be a contingent response to changing contexts. When comparing the type of interactions when showing work at events and exhibits to the collaborative exhibit and data collecting work conducted with Briazu and Francis, insights arose on the differences between these forms of collection. Although the data collection in this collaboration followed established forms which are universally accepted as representations of truths. We were critical of whether such a manipulated experience

and collection of a specific action had as much ecological validity as if the experience would have overspilled as described in the interaction of sharing stories above (Francis et al,. 2017). In our discussions we considered if a debriefing process, integral for a psychology study with human participants, actually means that participants do not later generate their own conclusions which may lead to stronger ideas exchange. Especially as ideas exchange may not be an immediate process but may trigger ideas over time. Also, as discovered in Chapter 3, a measure can stand in the way of an object of study. That being said, the ethical code of participant research in psychology is in place for the safety of the participant and I was honoured to have a glimpse into this process. I believe it helped me and my fellow collaborators to refine in our own minds what evaluation processes might be beneficial to share across borders and in which circumstances. This is in support of the maintenance of design judgements (Nelson and Stolterman, 2012, p.139-159).

Another reason why change in this work might be hard to capture is because it is happening over time in the mind of the audience and not necessarily at one moment. It seems we are applying orthodox methods of capturing change to an unorthodox aspect of design. In which cognitive traces may linger and may not have impact for long periods of time. Or which is dependant on individual mental model states. Change in mental models may also take various shapes; new cognitive traces may be added by sharing ideas someone may have not already thought about, cognitive traces may replace others by altering someone's opinion or cognitive traces may reinforce existing mental models. This may become more visible over time as correlations occur. For example, it is difficult to definitively prove that the iPad was informed by designs of interfaces in the film 2001 Space Odyssey, but it is likely these ideas may have been one of the many things that formed the inspiration which led to this product. One particular means of evaluating the making was in the active writing involved in this thesis. Through the iterative process of making and then capturing the process in text in a cyclical process the writing became a means through with to evaluate and consider what design judgements had taken place and what effect those design judgements had on the next iteration of the physical work. This was a two way exchange, the physical making also revealed ideas I had been writing about. This process was therefore dialogic as both differing forms of outputs shared the goal of "furthering, altering, improving or

expanding on something" (Frayling, 1993) as evidence of research through design processes often do.

An interesting means of evaluation of my own work can be seen by Steven Santer, a masters student of design futures at Royal Melbourne Institute of Technology. Santer (2020) has recently done a PESTLE evaluation using my *Transfigurations* (Haines, 2013) (*fig.25*) project as a case study. A method usually used in strategic analysis in market research for assessing the business potential of an idea. PESTLE stands for political, economic, socio-cultural and technological. A PESTLE evaluation usually involves analysis of the trajectory of impact an idea may have in these categories. The reason why this method for evaluation is fruitful in the way Santer has approached it as it is that is explores the primary, secondary and tertiary domino effects stemming from this idea. Santer has evaluated speculatively through considering the consequences, drawing from current social systems such as policy. Using speculation as a means to gauge the possibilities and even viability of speculation. This is incredibly insightful for me to evaluate my own ideas, but again does not offer empirical evidence.

As mentioned in 1.3.2. Audience, the notion of audience is distributed throughout this thesis and frequently returned to. Audiences are described here not as passive attendees or observers to (for example) exhibition events but rather active "publics" (DiSalvo, 2009). This thesis describes how the publics are inclusive of audiences attending events but also collaborators. This format has been a helpful means to present ideas exchange and transdisciplinary collaboration as it happens in real life. In that ideas develop over time and often sporadically as information is shared. An isolated segment on audiences may have helped me better shape publics, but may have not shown how audiences play an integral role throughout the entirety of the making process.

This thesis expresses that ideas or cognitive traces reside in the body of the designer, the collaborators and the publics, although this does not reject object-oriented-ontology and the concept that objects can too contain narratives and ideas. I have made a decision not to include this so that the focus can be on how ideas move between bodies and how this may influence design. This has been explored using Zics' (2008) work on "transparent medium" between the "artist-artwork-spectator interrelationship". Omittance of further exploration on this may be fuel for further work, but its inclusion

may have driven the argument away from the goal to pull design and the body in closer colloquy with one another.

In relation to the theoretical methodology, this thesis combines references from many sources external to design as a means to accumulate and draw from disciplines which may have knowledge on the topic of the changing body and therefore might be beneficial to designers. This decision showed that many views are contingent on one another and I have found this helpful as a practice based designer to better situate my own work amongst a history of analogous practices. Many of these references were suggested to me by collaborators, or were significant as they represent helpful insights about the body that may impact design. Although these references only skim the surface of these large discourses, for example, disgust is a vast research area in psychology that is only briefly touched upon here. I hope this may set up the foundation for further exploration into how design may better generate ideas exchange by understanding these topics through the lens of design. As mentioned on p.123 through taking ownership of terminology external to but associated with design, the practice of design becomes involved in generating knowledge.

On a final note in regard to methods of the practice, the text and images in the portfolio are not fully representative of the exhaustive research and efforts that went into the making of these works. Like most practice-based researchers I have highly curated the images showing the making of and final outcomes of these works. This text creates an overview of the topics of design and the body that relate to the portfolio as a whole, but each item in the portfolio explores specific elements of this relationship. For example, *if you prick us, do we not bleed?* (annex: Portfolio) *(fig.folio43, fig.folio44, fig.folio45)* considers the relationship between design and the body specifically in relation to artificial intelligence and humanoid robotics. For this work much research was done on animatronics and robotics currently occurring in healthcare stemming from the work done at companies such as Honda and Boston Dynamics in regard to anthropomorphic robotic design. Another example being *Acoustic Osteology* (annex: Portfolio) *(fig.folio32, fig.folio22, fig.folio34, fig.folio35),* which considers the relationship of design and the body specifically in relation to sonic technologies. For this work during a research residency at Etopia in Zaragoza, ultrasound was explored as a means of encouraging bone growth and therefore as a means to redesign bone. The

differing focuses of the research for these projects is not touched upon in the text for this thesis. More details of these works can be found in the appendices and list of related publications above. Many works and the research that went into their development conducted as part of this thesis are described in presentations listed above, many of which are recorded and can be found online as well as on my practice website. This omission was not intended to hide elements of the practice-based methodology but instead to focus on the nascent methodologies and materials that are most significantly revealing the model of design at the time this thesis was written. The practice based methodology also intended to include materials as they are more recently considered, as abstract (Nelson and Stolterman, 2013). The materials involved in the practice based methodology therefore are also inclusive of the writing and the publics engaging in the work. Taking into account that materials are becoming more provisional, intangible and speculative. This thesis is a representation of the shift in design, for which my physical work plays a part. For the purpose of building a connoisseurship (Nelson and Stolterman, 2013, p.151) or sensibility to the design model described in this thesis.

6.3. Ideas Exchange

A study in 2017 sums up concisely what I have learnt about the artefacts of speculative design in making models of design. In 2017 Slominski et al. did a study of drawing abstract concepts in neuroanatomy by researchers at varying levels in the discipline. They found that drawings by students more closely resemble those in a standard anatomical atlas whereas "professors communicated a more abstract idea of a neuron, and their representations seemed to reflect their own research endeavors" (Slominski et al., 2017)[163]. This tells us three things; firstly, the artefact creates a model that communicates how to understand function. Secondly, there can be multiple models depending on who has made the image and what story it tells. Thirdly, those who have a sensibility towards comprehension of the neuron include ambiguity in its representation. Just as the artefacts of speculative design communicate to understand, create multiple models and include ambiguity. The artefacts no longer represent *correctness* or *truth* as Vesalius intended in *Fabrica*, but instead they are the

[163] Although this research is a valuable shift to drawing as a more complex representation of knowledge, different to the questionnaires they mention. There is little description of how other representational styles or techniques may have influenced participants at each level. There is also confusing use of the term 'inaccuracy' when they are trying to represent seemingly abstract concepts, I assume this means inaccuracy in comparison to current anatomical renderings of the same subject matter.

representations or imaginings of abstract or loose concepts. They show things yet to be seen as concepts that alternative ideas can be projected on to. Those with a sensibility toward design create even looser mental models to allow for mobility in thinking.

> Wandering outside the fringes of my discipline provided the opportunity to learn more about psychology and the arts; crucially it has taught me more about myself and my research practice. (Briazu, 2017)

Another concluding realisation is summed up in a paper by Raluca Briazu (2017), she describes some of the discomfort and joys in a collaboration that we undertook together; specifically in relation to ideas exchange. Identifying the cognitive effects she experienced. Briazu's (2017) paper written after our collaboration is perhaps the most salient document of ideas exchange connected to my practice that is recorded by someone other than myself. Briazu mentions that our collaboration (also with Kathryn Francis) left imprints in the way she considered her own work and work external to her discipline. She writes that in some cases interdisciplinary discussions reaffirmed her beliefs. This describes a significant cognitive trace, but perhaps not the one someone might traditionally wish to instil if coming from the other side of the argument, but still a trace none the less. In starting this PhD, as a designer it was difficult to rid the hubris that the cognitive trace was not one designed or constructed conclusively by my work. An attitude often implemented in design schools that work can have a pointed affect. This has taught me significant lessons that the exchange might happen at one or multiple points and that the trace is not susceptible to manipulation so explicitly. As Blassnigg and Punt (2013) write of transdisciplinarity for myself and my two collaborators it seems our exchanges caused a "reevaluation" created through the bequeathing of a cognitive trace in the form of ideas exchange. For myself this reevaluation was incredibly valuable, and the cognitive traces from these exchanges have remained with me, helping me form new mental models of design, and from Briazu's paper, it seems this feeling is mutual.

This shows that ideas exchange does not always happen at the point of experiencing a design outcome but can occur during its process, therefore the weight of "creating discussions" (Speculativeedu, 2020) should not solely be placed on the end result, but also the means through which it got there. Although I am of the opinion that the gallery space, where many of these design outputs are experienced is an

environment for thinking[164]. In the case of speculative design the artefacts that end up in these environments should not be considered final. The fact that many of the designers whose work is referenced in this thesis are not solely exhibiting designers. The outputs of the work often takes multiple formats as it has done with *The Anatomy Lesson*. The artefacts therefore are somewhat a manifestation of ideas exchange and a reflection of it towards an audience to invite them to experience the same sensation. The case study of *The Anatomy Lesson* retrospectively was an attempt to instil my two experiences of research artefacts that opened this thesis, but also a mirrored reflection so that I might somehow share the cognitive trace which was left with me with other publics. Tonkinwise (2015) writes

> if the designer is sitting alongside the scientific researcher, sketching amoral or even immoral implications, then the scientific research expert is the audience. The critical designs can then impact the very people in a position to respond to those designs. (Tonkinwise, 2015)

This collaborative moment described by Tonkinwise is exactly when much of the ideas exchange occurred. Assuming designers do not do this puts weight only on the resulting outcome of design and not on the research process which led there. According to Briazu's paper it seemed it was the process of the collaboration or even the initial moments of instigating the project in which most ideas exchange took place. The resulting objects and outcomes show things yet to be seen as concepts that like the neurons mentioned above, alternative ideas can be projected on to by those external to the collaboration.

6.4. Speculating on speculation

Fiction often appears indulgent to the designer who, according to research in this thesis, should feel the moral obligation to be attempting to make in the service of bettering society. The question is, will fiction in design remain relevant? Design has always been forward thinking so the fictional aspect of this endeavour is what explores the implications of current decisions to be made. In considering the trajectory of the science fiction novel, a continual reference of the speculative designer, trends seen in science fiction writing may be somewhat mirrored in speculative design practices. Creating models that concern the shape of the future could on the one hand be a

[164] Another critique of speculative design not outlined in this thesis is the question of whether it should occupy gallery spaces.

response to Toffler's *Future Shock* (1970). An overwhelming discomfort with swift technological and social change. These models can then offer ideas of systems to live by. In J.G. Ballard's book *The Atrocity Exhibition* (2014) in which characters deal with an overwhelmingly fictionalised society. He called this "a handbook for survival" (ibid.) in that the fiction may somewhat model the discontents of current reality. Although according to writer William Gibson (2012) there is a movement of "future fatigue." Describing the end of postalgia, in that there is a dissatisfaction that "Upon arriving in the capital-F Future, we discover it, invariably, to be the lower case now" (ibid.). According to these distinguished science fiction writers the future context has forever been a critique of the now, whether design may begin to more fully explore fictionalised alternative presents like in *The Atrocity Exhibition* is yet to be seen. I speculate that the fictions of the future will continue to be evident in design but will change shape in relation to the present as they have been doing in speculative design. It is through elasticity (Antonelli, 2008) that it can shift and continue to have relevance. Without reevaluation of how futures are fictionalised, the elements that have become fruitful for design thus far may die a death, and without forms that may help model complex concerns; models for the future may lose the "projection screen of present-day concerns and desires" (Yberna, 2004).

As Tharp and Tharp (2018) write "it is not just 'design with a voice' but rather a particular quality of messaging." This thesis has argued that the messaging can ignite a cognitive trace through the exchange of ideas. The ideas exchanged are manipulated through the strategies of design. Not always, it seems, fully controllable by the designer but able to encourage a "system of thought" as Tharp and Tharp (2018) might say. Hence why this form of design is predominantly transdisciplinary and therefore functions as adjunct. In returning to the key aim of transdisciplinarity quoted at the beginning of this thesis by Blassnigg and Punt (2013, p.3) it is "to facilitate emergent insight, knowledge and interaction that could not have been foreseen or designed in anticipation of a specific outcome or solution to a problem." Forms of transdiciplinary exchange need to be better facilitated so that design is not considered an illustrator of other's ideas, but instead can use its mobility of thinking to explore and add ideas in the direction of others. The imaginative processes involved in speculation are what allows the *yes and…* open mindedness to create new vocabularies that can engage with

collaborators intra and external to the design discipline. I hope that through these transdisciplinary exchanges speculation will continue to be a tool for exploring the extremities of design rather than a stylistic choice.

6.5. See you in the futures

In returning to the introduction, the main focus of a practice based thesis text is to contextualise creative practice based work (Candlin, 2000). The function of this text is to situate my work amongst a heritage and continuing trajectory of design with the aim to build connoisseurship (Nelson and Stolterman, 2012). This is in order to consider where my work is situated amongst contemporary practitioners and how to better articulate the intentions behind it. This is also to show that my practice, and those of my contemporaries, does not solely sit in design, in the case of my portfolio it should also be contextualised in association with the trajectories of anatomy, as seen in Chapter 3 (Body) as well as in disciplines such as biology, film, theatre and psychology as explored in Chapter 5 (Body - Design), revealing the adjunctive design it originates from.

In much practice based design PhD research practice is often informed by acquiring data or methods from participant research. The knowledge gained from practice in this thesis rather highlights insights gained throughout the making process and from the ideas exchanged via the artefacts themselves, which involved insights from collaborators and contemporaries.

It is also worth noting that the practice based work, although being predominantly research through design, can stand alone, external from the connection to the text. I am delighted to be celebrating the final words of this thesis by describing the extensive body of practice based explorations and the rich networks that have been created through their conception. Throughout the six years of this thesis research, eight significant projects have been produced which have informed the arguments in the text. Two of which were long form and highly investigative projects; *The Anatomy Lesson* and *Drones with Desires,* which were both part of a year long residency. As well as *Alter-Terrestrial* which was also a year long project which has been exhibited in its current state but is still ongoing. In many cases these have been the results of awarded funding and residencies or invitations to collaborate, all works have been exhibited to

the public in different capacities mentioned in the portfolio descriptions. The preliminary research for, and the resulting objects have, become things for thinking. Not just artefacts that may, through their materials, entice thinking but are constructed to induce ideas exchange, as Tharp and Tharp would say: they are "goods that are good for thinking" (2019). The thinking is not resolved but continues both as the context of the work changes and audience changes. This ongoing ideas exchange is still occurring in myself as a designer as input means I can continue to reevaluate the tools of design. As the mental processes which shape the work in turn shape design and shape the mind of the designer, in this case myself.

Situating speculative design as an adjunct might mean it is given intellectual autonomy to engage seriously in other disciplinary territories. It can then act across disciplinary membranes to engage with wicked problems in order to create artefacts that through their production and propagation might elicit enduring cognitive traces. The aspirational trajectory of this work, is that designers may take part in the creation of a wider multiplicity of heterotopian future models. Particularly those which focus more on the relation between the processes of design and processes of the body to inform models. Informed more fully by collaborative effort if it is contextualised alongside them, and inviting a wider range of publics who can input currently underrepresented visions of future models. Then, the currently youthful qualities of this design approach may be more fully articulated through its longevity and multiple threads of future models of the body which currently remain unseen and which I aim to continue to explore.

Before closing I want to revisit the artefacts mentioned in the introduction; the plastinated face and silicone jaw. In the making of this research I have purchased more glycerin, silicone oil, odourless hand soap, KY Jelly, vege-gel and ultrasound gel than expected for a thesis that is not about slime. The research artefacts at the beginning were brought out as a means of raising ideas to the surface. The objects of speculative design on the other hand, orchestrates which ideas should be brought to the surface. Creating intentional and facilitated idea exchanges through the use of tactics. This is not necessarily to create spaces for discussion and debate but to control and even direct ideas towards specific topics and concerns so as to have a stake or input in their modelling and therefore eventually in their change. The artefacts of speculative design

act as a lubricant to diminish friction found in the communication of wicked problems, and in doing so promote sfumato across the membrane of disciplines such as models of the body. To then answer the question; why isn't it slimy? In regard to the role of speculative design artefacts I would say, they are.

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8. APPENDICES

APPENDIX 1: PORTFOLIO

This is a collection of design works which were created during the conception of this thesis. Many of the projects here are mentioned throughout the text and represent pivotal moments which align with the formulation of the ideas within the text and many appear as references in these cases. Each of these projects communicate aspects of the post bio-tech-body, with an overarching focus on the propensity for design to reevaluate the nature of the material of the body in the face of nascent biomedical and healthcare technologies. All works engage in different ideas associated with the post bio-tech-body as a manipulable material for remodelling and the consequences of it entering the designer's toolbox.

All the works below have been published in exhibitions, conferences or talks and contain a brief description and notable publications title which can be referred to in the related publications at the beginning of the thesis.

(Any works referenced but created prior to the award of my PhD studentship with CogNovo and TransTechnology Research are included in the figures)

I have not included Transtechnology Research or CogNovo in the collaborating bodies or thanks as these apply to all projects, including the support of my supervisory team. Professor Michael Punt, Dr. Hannah Drayson, Dr. Martha Blassnigg, Dr. Mona Nasser, Professor Sue Denham, Dr. David Moles.

The Anatomy Lesson: Dissecting Medical Futures

Funded by: Awarded fellowship, funded by Amsterdam Fund for the Arts 3Package Deal. BioDesign team supervised by Waag Society, Mediamatic and Vrij University

Collaborators: Mona Nasser, Sean Clarke, Jeoren Noordhoek, Vaibhav Tyagi, Lucas Evers, Willem Velthoven, Tobie Kiers

With thanks: Michael Punt, Patricia Pisters, Mike Thompson, Marleen Strekker

Here lie four specimens of the future represented on dissection tables of a not too distantly imagined anatomy lesson. Like current procedures learnt through working with cadaverous or modelled material, these sculptures show imagined surgeries that deal with the onset of new enhancement technologies being introduced into the body. With advancements in biomedical and healthcare technologies the body is increasingly considered a site of change. Yet the exciting prospect of bodily advancement and enhancement is rarely represented from the view of the professional practitioner who will have to implement or maintain this technology. In a quasi-simulation of future medicine, the audience can probe futuristically modified body parts in order to consider how we might prepare for procedures such as removing a cyst that has developed on a bionic eye implant, or how to clean a nanoparticle filter from the trachea.

May the use of futuristic moulage encourage us to reflect on what kinds of bodily alterations are worthy of continued research and development? Or more importantly might we reconsider altering ourselves, the potential future patients?

Exhibitions:

Waag Society Amsterdam

Gogbot Festival

Science Gallery London

Arti et Amicitiae

Albert van Abbehuis

Performances:

Science Gallery London

Bellvue Theatre Amsterdam

Shapeshifters

Kikk Festival

Frontiers conference

fig.folio1: **The Anatomy Lesson interactive performance**

fig.folio2: **The Anatomy Lesson set up at Waag location**

Teratoma tooth transplant

Often as cancerous growths develop in the body they can begin to grow cells that are foreign to the site of the tumour. Some tumours can begin to cultivate hair and even teeth; this procedure encourages the alternative production of teeth for implantation through teratoma growth. This means that if a patient begins to develop a tumour, in a controlled fashion cells from the mouth may be able to be produced from the growth, and then removed during tumour removal for implantation in a gap in the mouth.

Although tumour production is sensitive, the idea that a positive result may form from the development of a growth means that the body can then be seen as a site for material development.

The growth is to be removed from the site it has developed and the tooth extracted from that, it can then be inserted into the mouth and filled to keep it in place.

Please feel free to probe with your probing tools but ask for assistance in removing the tooth from the teratoma.

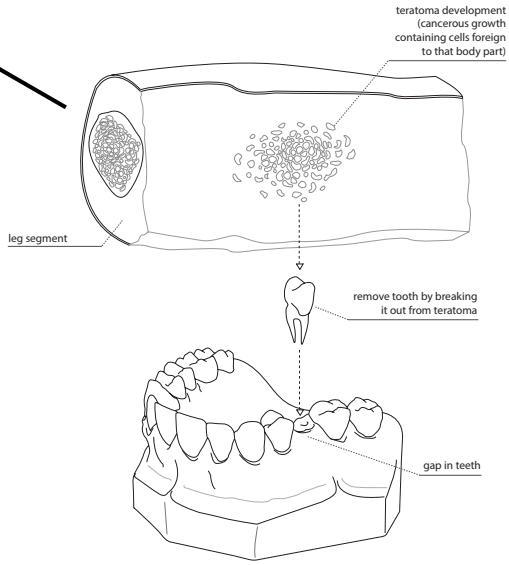

fig.folio3: **Teratoma tooth transplant descriptive text**

Nano Filter

Within some medical research there is a push towards getting items into the body but there is a struggle regarding their removal. Nano technology for example with its ever increasing global funding will encourage the prevalence of smaller and smaller particles for applications in body creams, foods and medicines, and now even in nano robotics. These tiny items can not only enter the body through the skin but also they are light enough to float in the air, potentially causing a new type of pollution that could have a detrimental affect on our health through inhalation.

Tiny items all with specific functions may enter the lungs and begin to accumulate; causing an extraneous growth that can affect surrounding tissues and functions. The insertion of a nano filter may encourage these tiny items to accumulate and collect within the filter itself.

Yet in highly polluted areas these filters can fill quickly and may need changing often, which although a simple operation can be uncomfortable and inconvenient for the user.

Please feel free to probe with your probing tools and endoscopic camera but ask for assistance in removing the filter.

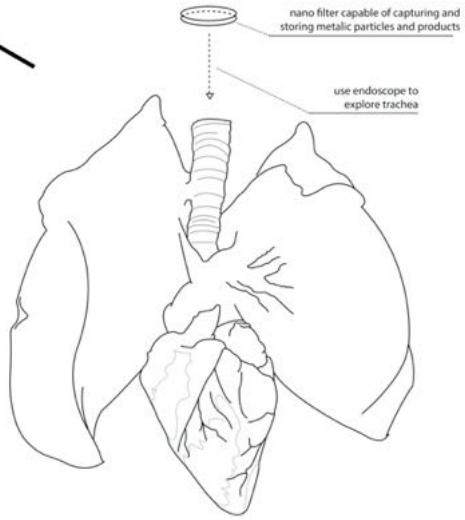

fig.folio4: **Nanoparticle Filter descriptive text**

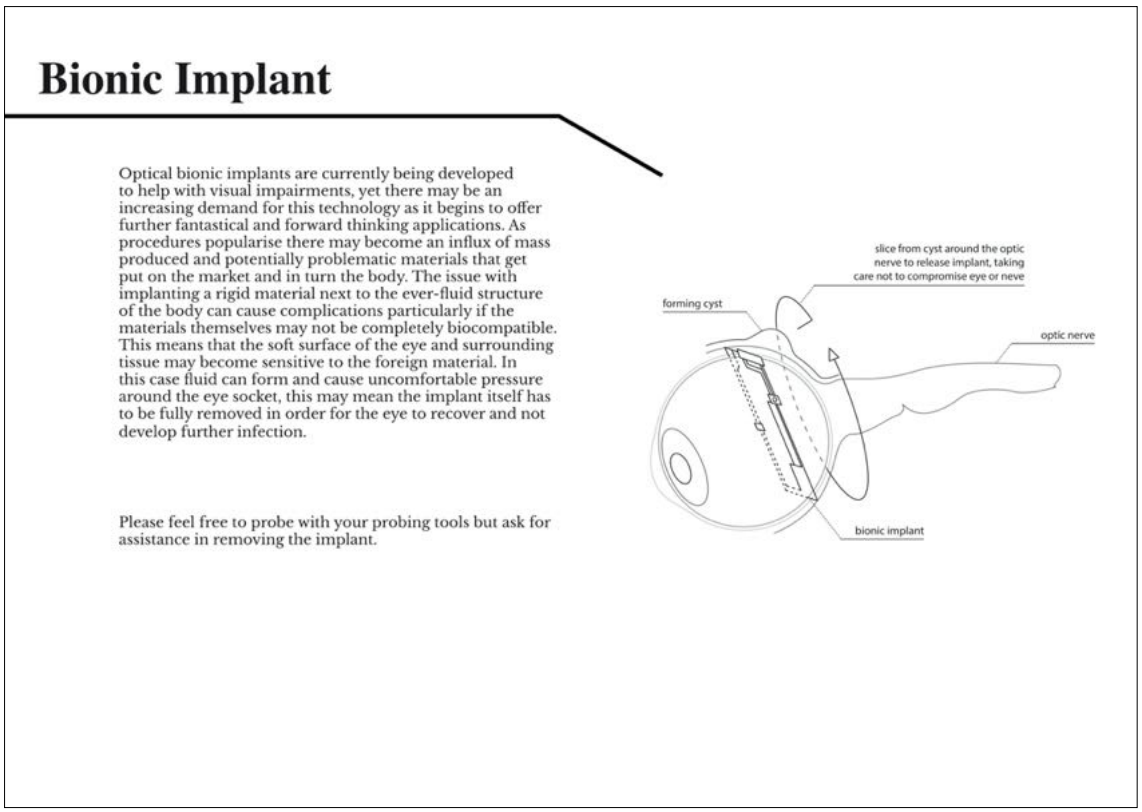

fig.folio5: **Bionic Implant descriptive text**

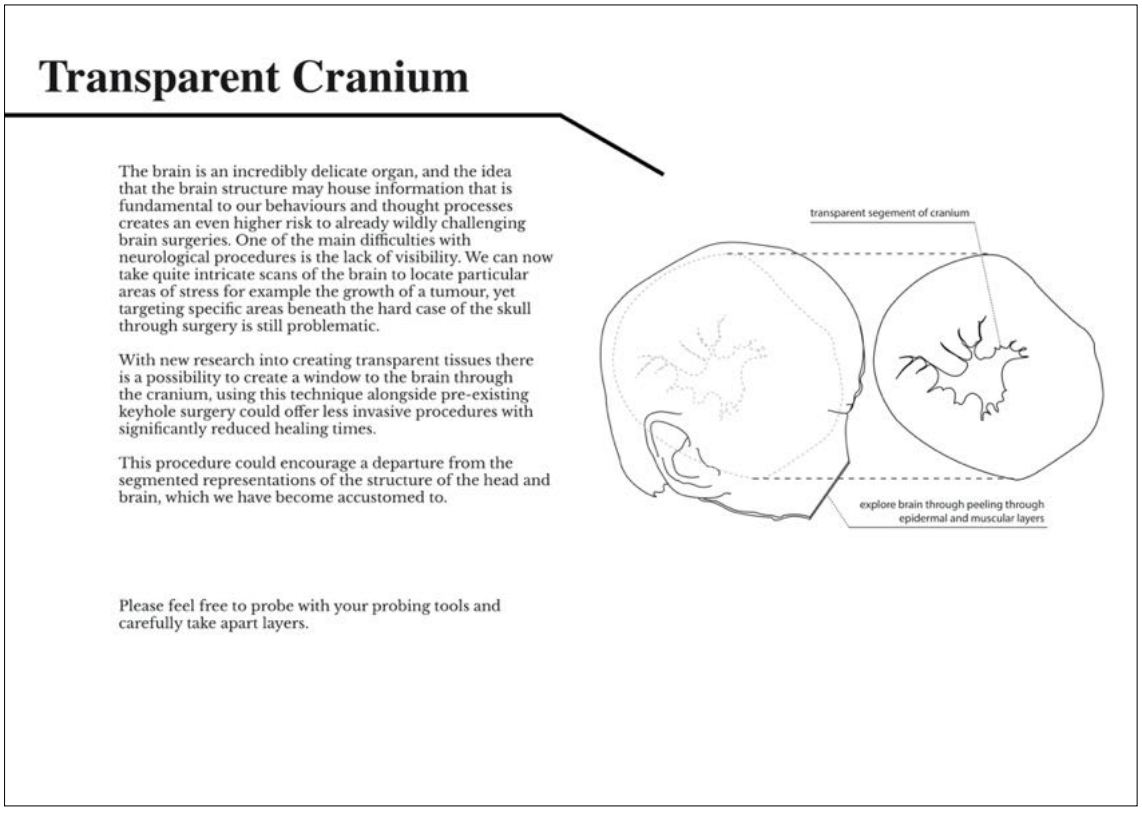

fig.folio6: **Transparent Cranium descriptive text**

fig.folio7: **Audience watching Anatomy Lesson film at Waag location**

fig.folio8: **Bionic Implant - Work In Progress Testing**

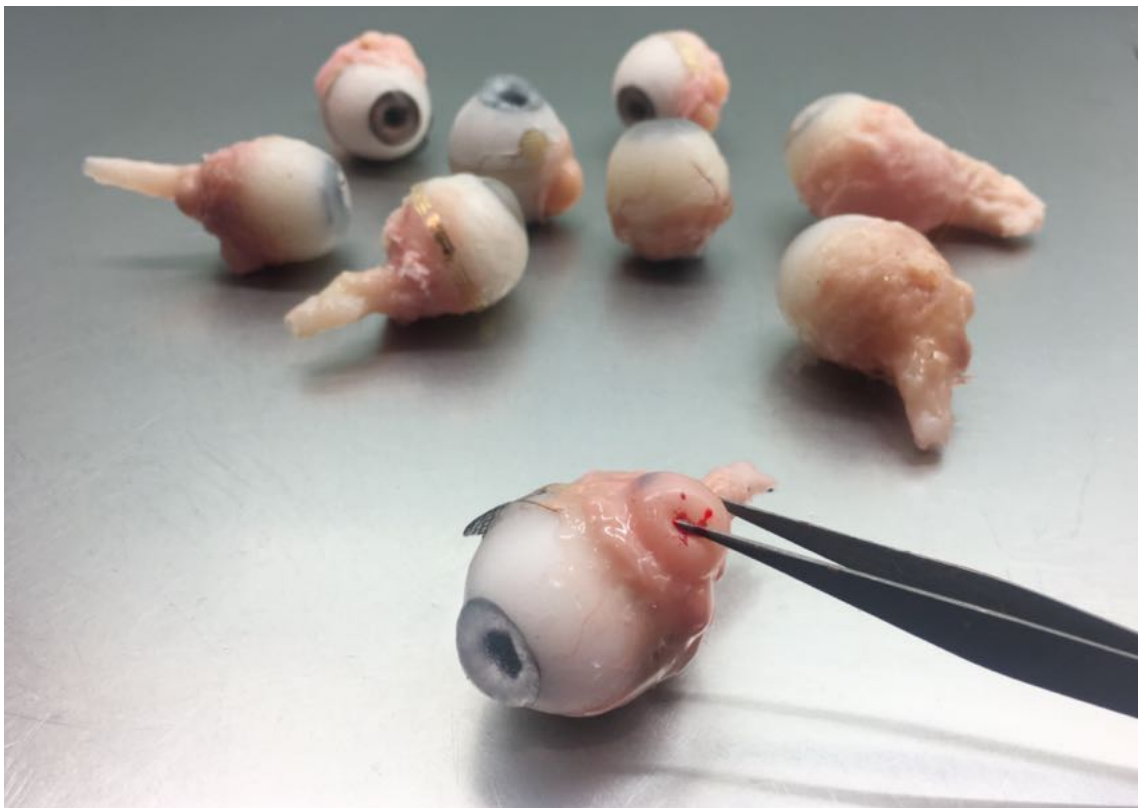

fig.folio9: **Bionic Implant**

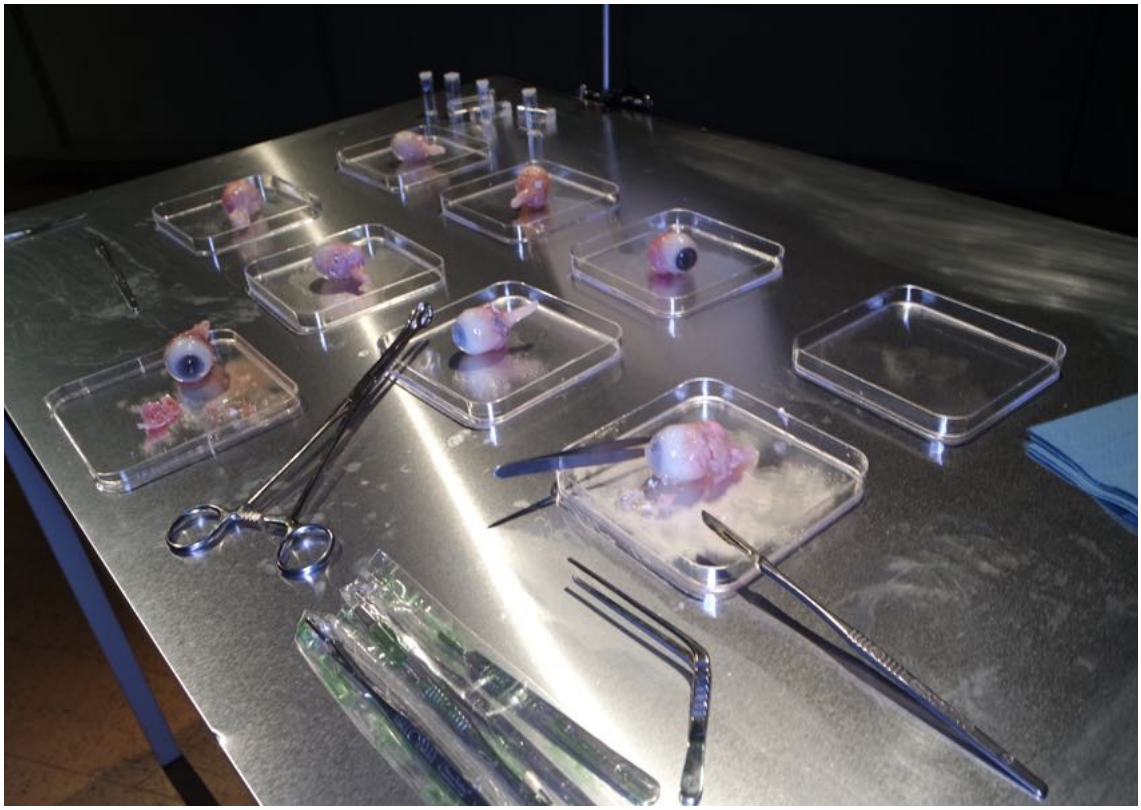

fig.folio10: **Bionic Implant at Waag location**

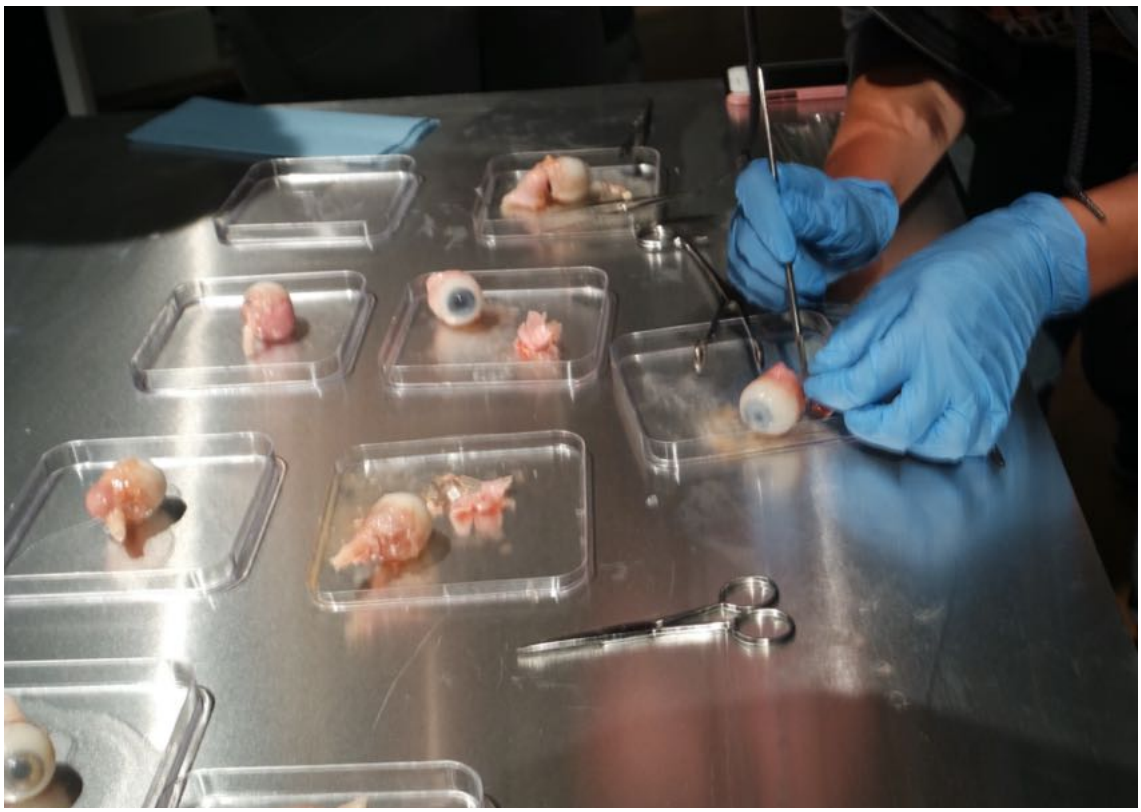

fig.folio11: **Audience member interacting with Bionic Implant at Waag location**

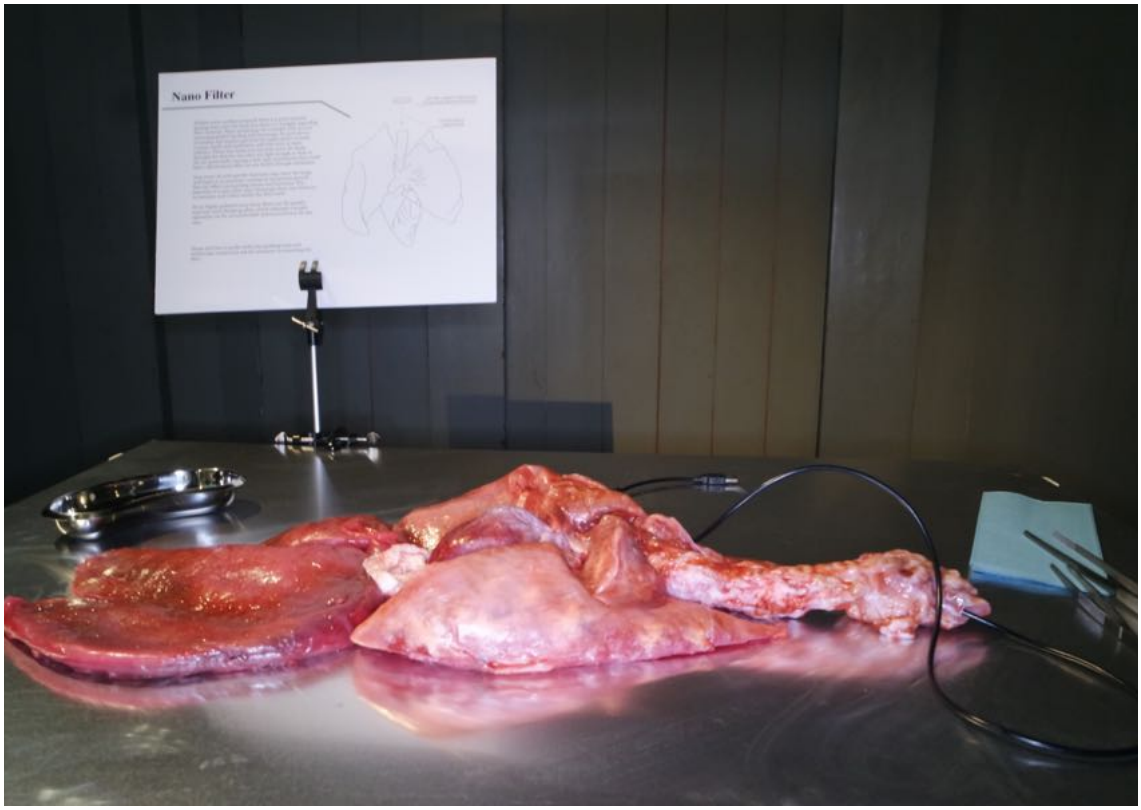

fig.folio12: **Nanoparticle filter sculpture at Waag location**

fig.folio13: **Nanoparticle filter sculpture**

fig.folio14: **set up of Teratoma tooth transplant at Waag location**

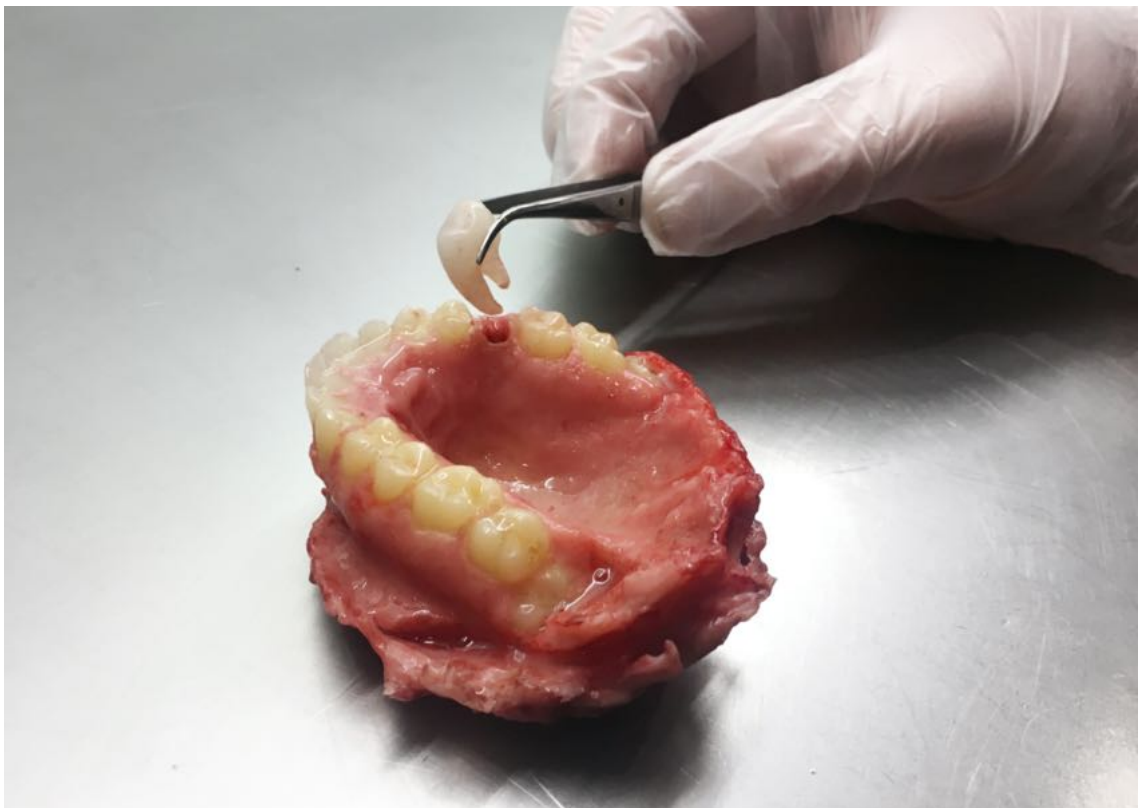

fig.folio15: **Teratoma tooth transplant**

fig.folio16: **Leg segment cut through**

fig.folio17: **Transparent Cranium**

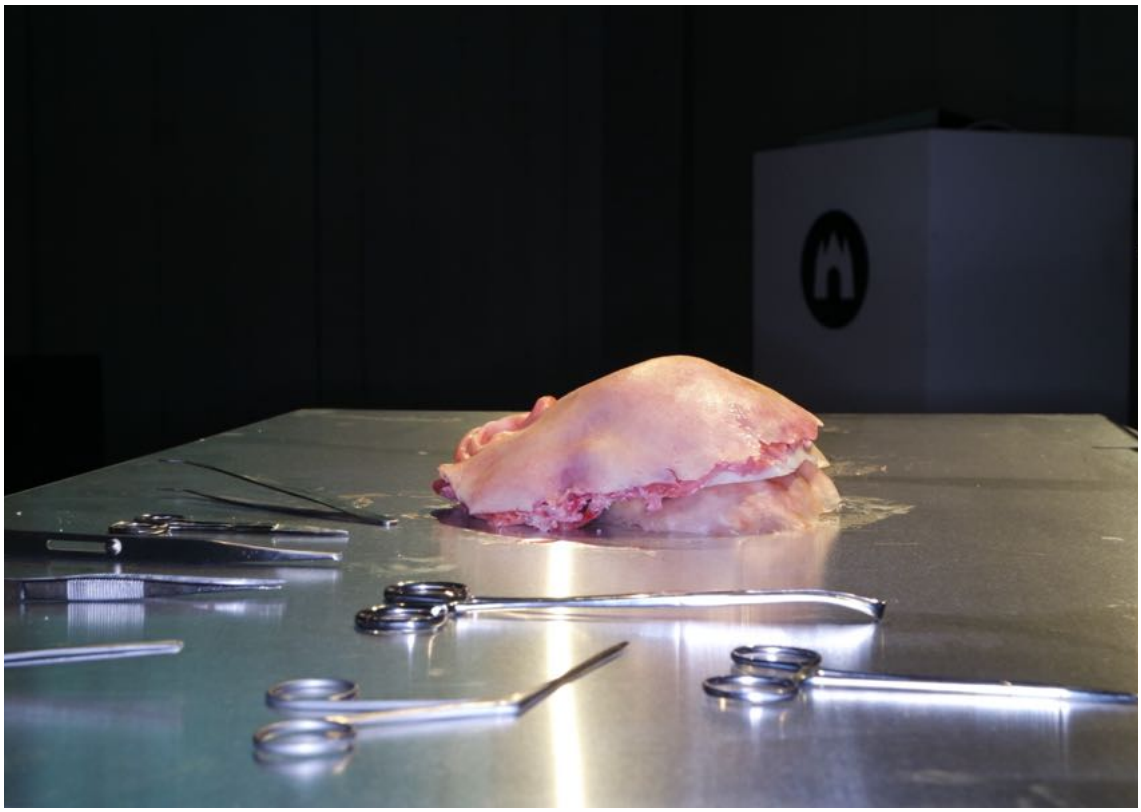

fig.folio18: **Transparent Cranium at Waag location**

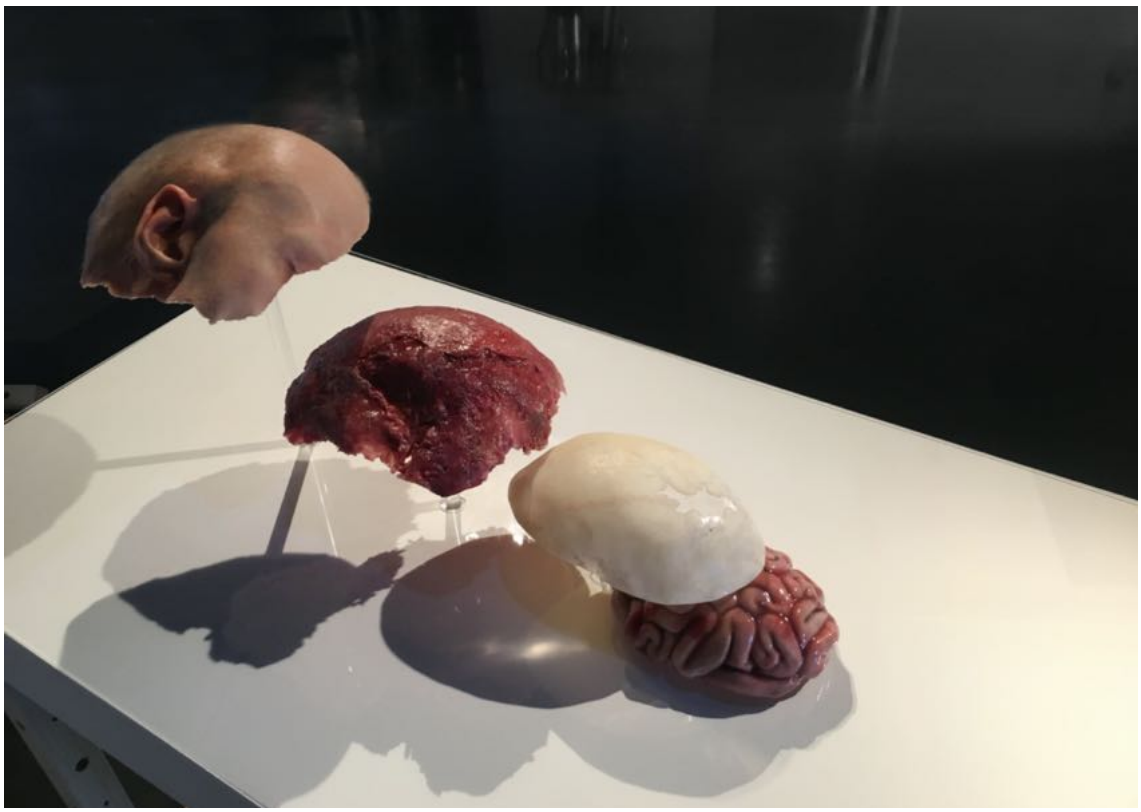

fig.folio19: **Transparant Cranium at Science Gallery, London location**

fig.folio20: **Transparant Cranium showing clear window in resin skull segment**

fig.folio21: **Work in progress. Sculpting the Transparent Cranium**

fig.folio22: **Audience interaction with Transparent Cranium**

fig.folio23: **The Anatomy Lesson at Science Gallery, London location**

fig.folio24: **Transparent Cranium and Bionic Implant at Albert Van Abbehuis location**

fig.folio25: **Bionic Implant Science Gallery, London location**

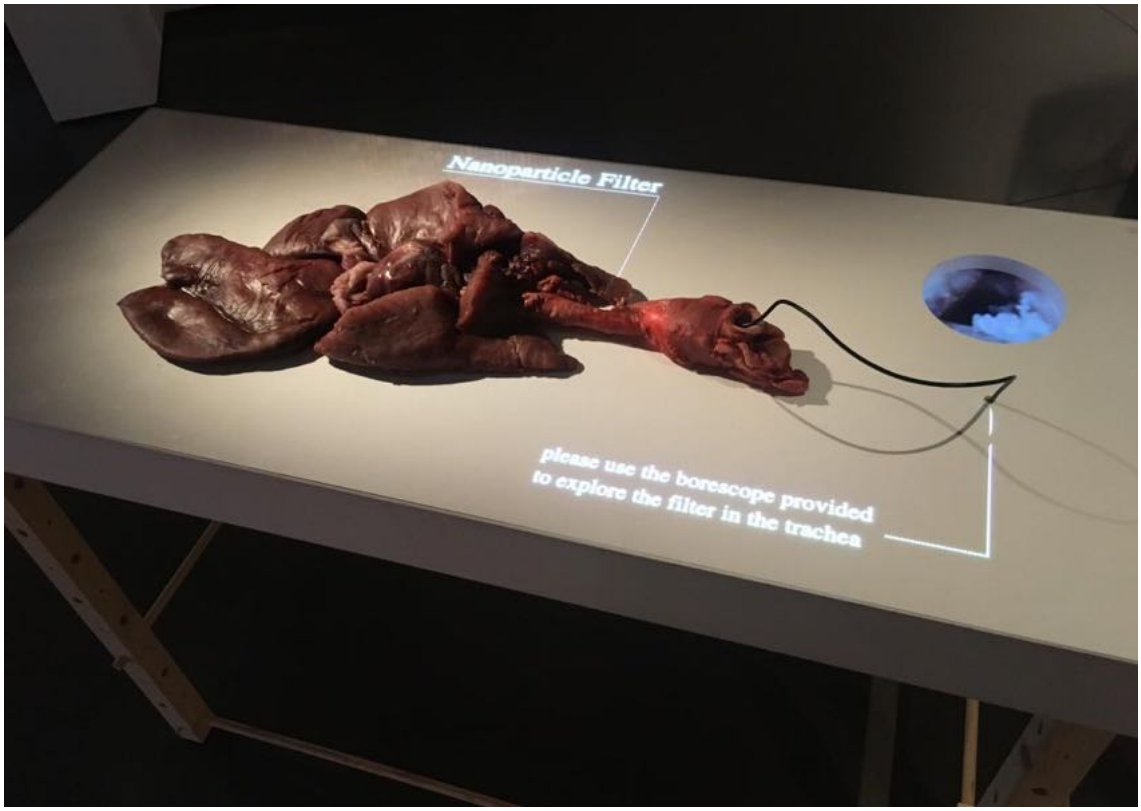

fig.folio26: **Nanoparticle Filter at Science Gallery, London location**

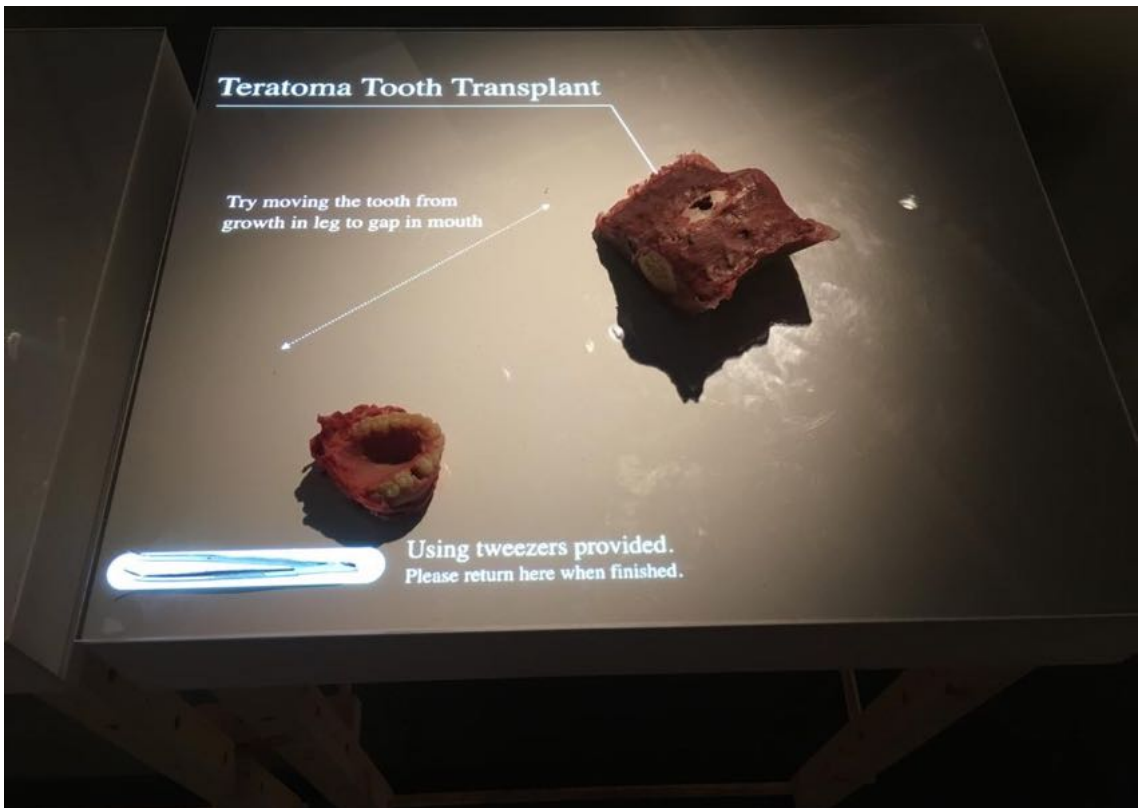

fig.folio27: **Teratoma Tooth Transplant at Science Gallery, London location**

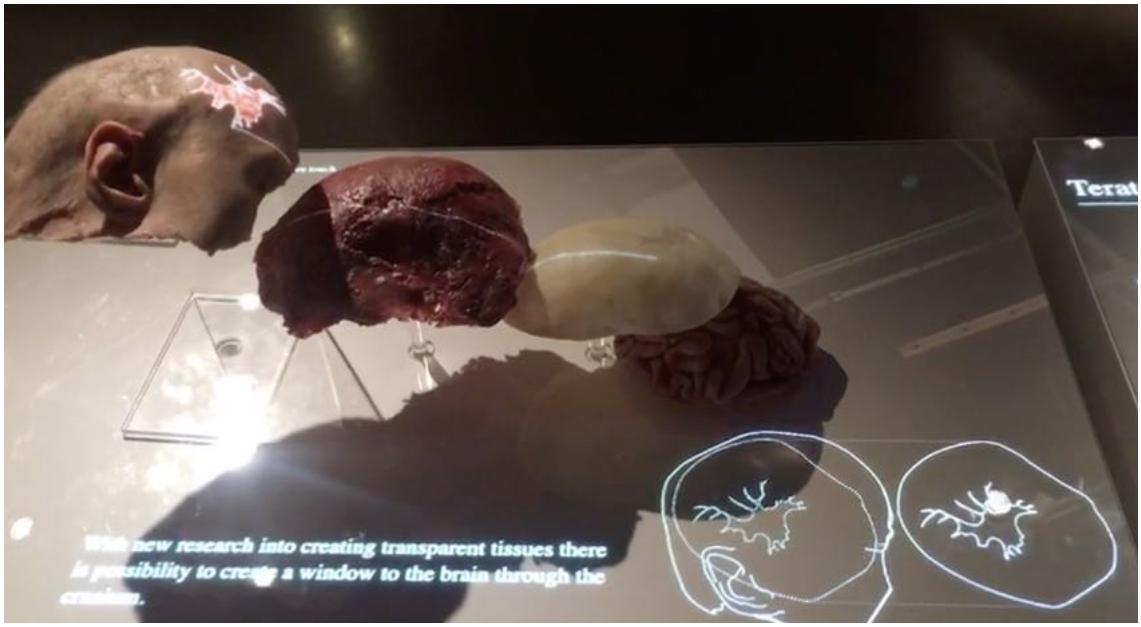

fig.folio28: **Transparent Cranium at Science Gallery, London location**

fig.folio29: **The Anatomy Lesson live performance at Science Gallery, London location**

fig.folio30: **The Anatomy Lesson live performance at Science Gallery, London location**

fig.folio31: **The Anatomy Lesson live performance at Science Gallery, London location**

ACOUSTIC OSTEOLOGY

Funded by: Radial dB residency, Etopia, Zaragoza

Collaborators: Sean Clarke

This project imagines how current methods of the medical use of sound might develop to code sound into the structural fabric of the body. The growth rings of bone develop with time similarly to the growth lines on a tree, these lines have been photographed with a microscope and then traced. The data from these traces was then translated to a chromatic scale revealing a complex auditory soundscape.

Through high intensity ultrasound it has the potential to encourage the osteoblasts within the structure of the bone to grow and the osteoclasts decrease. This has been trialled as a healing technique to increase the growth of bone cells in a specific area. The device shown imagines how a more precise wave may be able to actually physically alter the physiology of the bone itself. Meaning a new growth pattern can be introduced. This would allow us to actually alter the growth line as though it were a notch on a vinyl record, coding music or other data directly into the bone.

The exhibit below supported by Radical dB and Etopia and included two interactive spinning discs made from enlarged microscopic images of bone rings which produced sound when turned, and sculpture of ultrasound bone device.

Exhibitions:

Radical dB Etopia, Zaragoza Spain

fig.folio32: **Bone Slice**

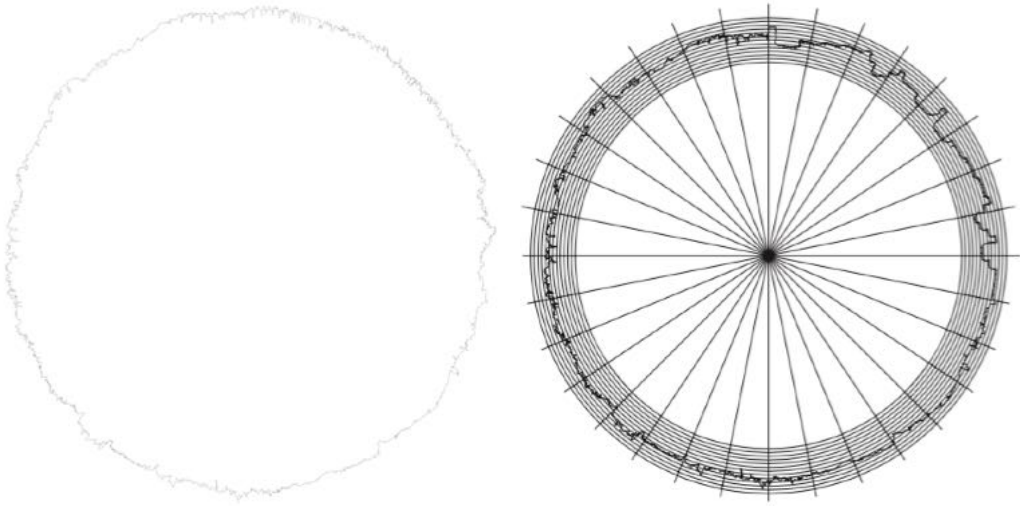

fig.folio33: **Left: traced lines taken from Bone Slice | Right: traced lines have been "coded" and mapped on to a musical scale**

fig.folio34: **Acoustic Osteology installation at Etopia center for Art and Technology location**

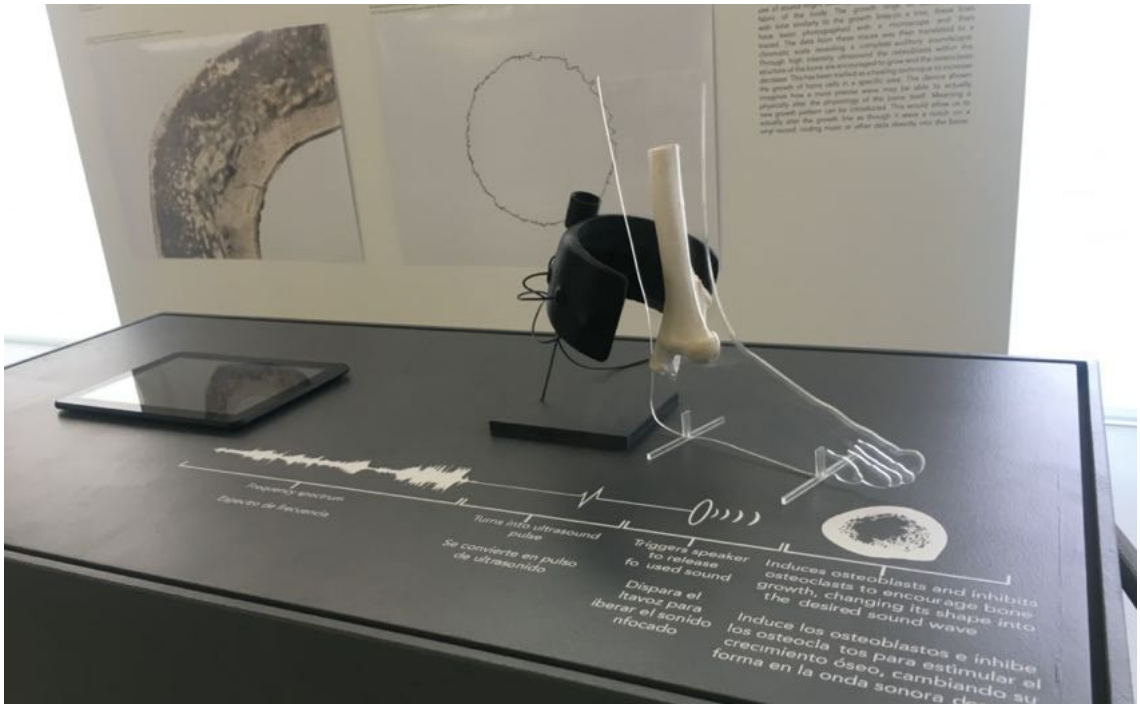

fig.folio35: **Sculpture of speaker coding sound waves into bone at Etopia center for Art and Technology location**

DRONES WITH DESIRES

Funded by: Bio Art and Design Awards

Collaborators: Marcel de Jeu, Jos van der Geest, Sean Clarke, Jack McKay Fletcher, Christos Melidis, Marcel Helmer, Vaibhav Tyagi

A drone that learns using an Artificial neural network based on the designer's brain data.

An MRI of the designer's brain was taken by neuroscientists at Erasmus MC Rotterdam and coded into an algorithm that learns about its anatomy and environment as the drone moves throughout the space. As the drone learns the network updates telling us how the plasticity of the brain might change if it was in a completely different anatomical structure.

The drone makes decisions based on comfort and curiosity, moving its wings to navigate. As it does so connections in the network alter their strength to replicate learning behaviour as it develops in the human brain.

Within the gallery a neural soundscape represents the most active nodes in the network and a live feed of the changing network itself.

Exhibitions:

Body of Matter Mu Eindhoven

Corrpus New media gallery New Westminster Canada

Taiwan design expo

Alter at Gus Fisher Gallery, Aukland, New Zealand

Bazarre Bizarre Off the Lip Plymouth University

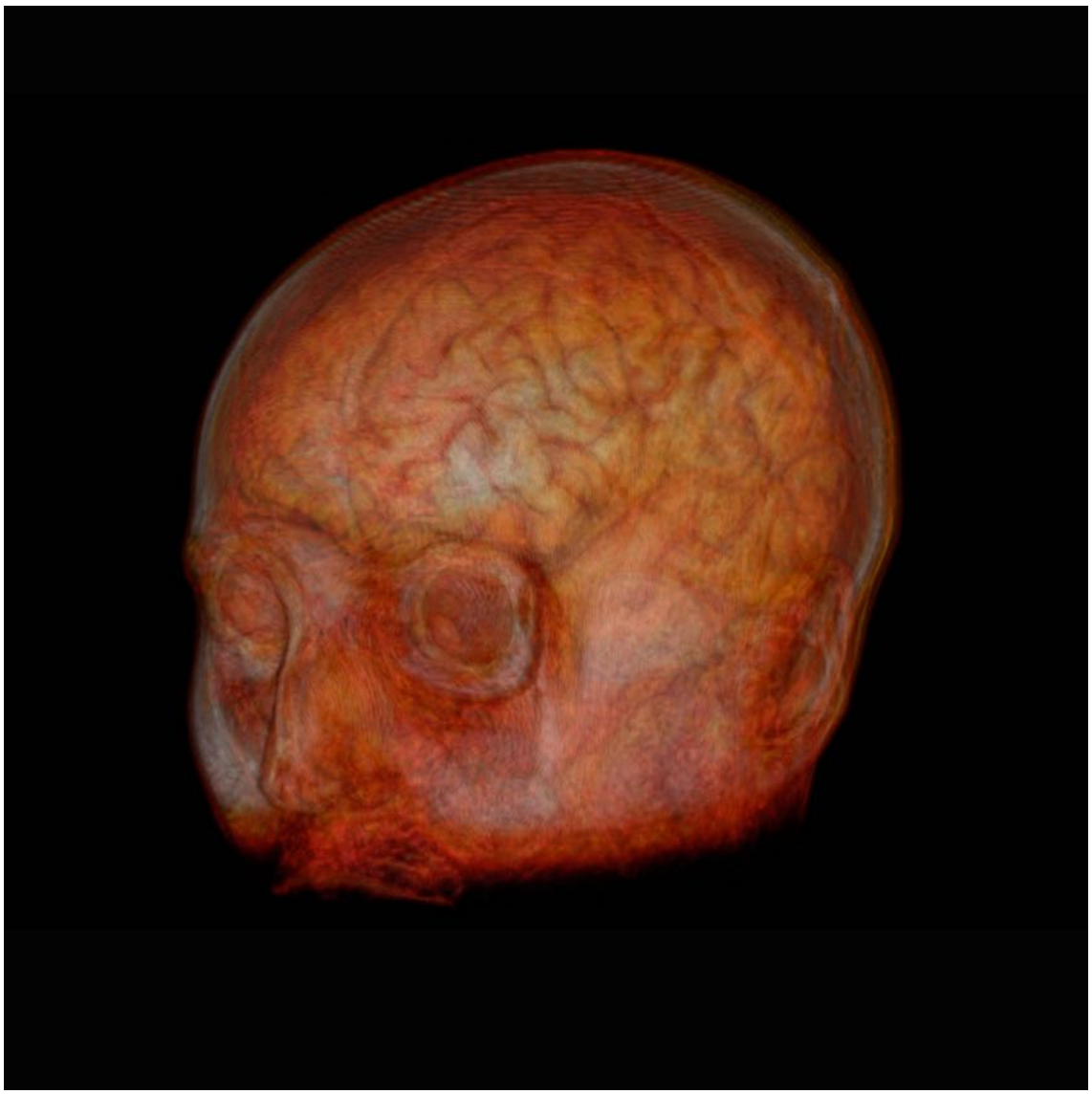

fig.folio36: **Scanned image taken of my head**

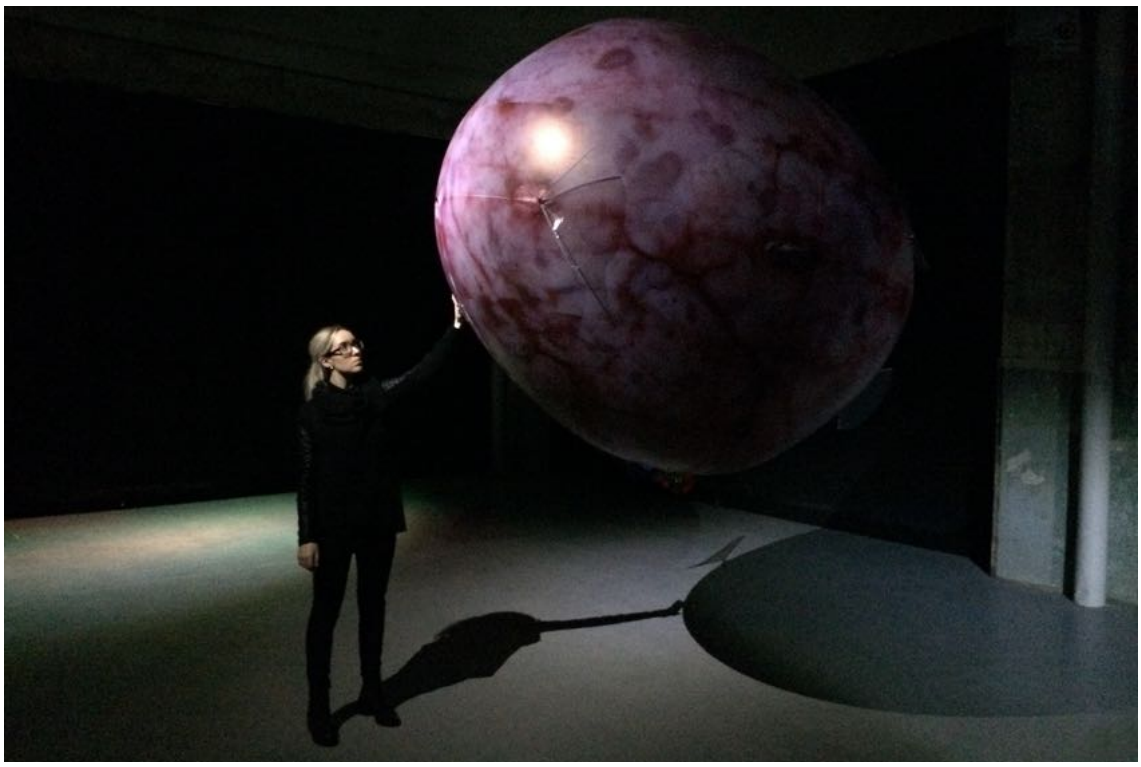

fig.folio37: **The Drone at Mu Gallery location**

fig.folio38: **The Drone and installation at Mu Gallery location**

fig.folio39: **Agi Haines preparing to have her brain imaged by a Diffusion Tensor MRI at Erasmus MC Rotterdam.**

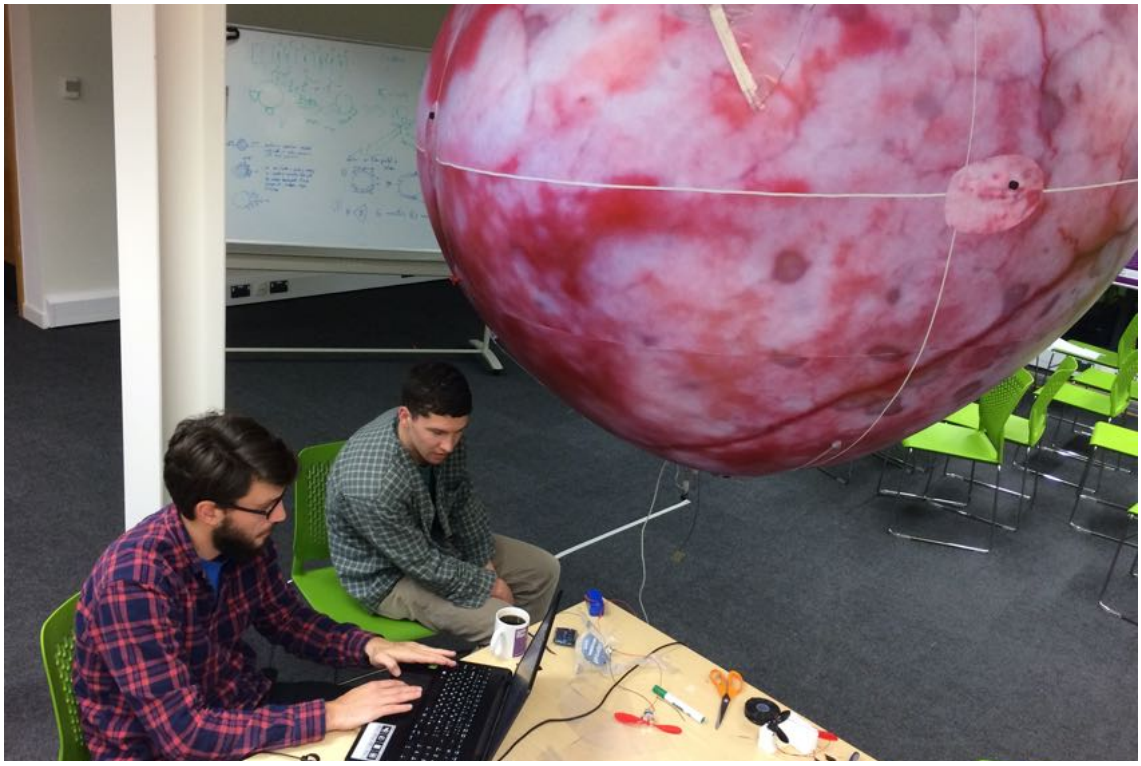

fig.folio40: **Work in progress: collaborators Dr. Christos Melidis and Jack McKay-Flectcher working on The Drone.**

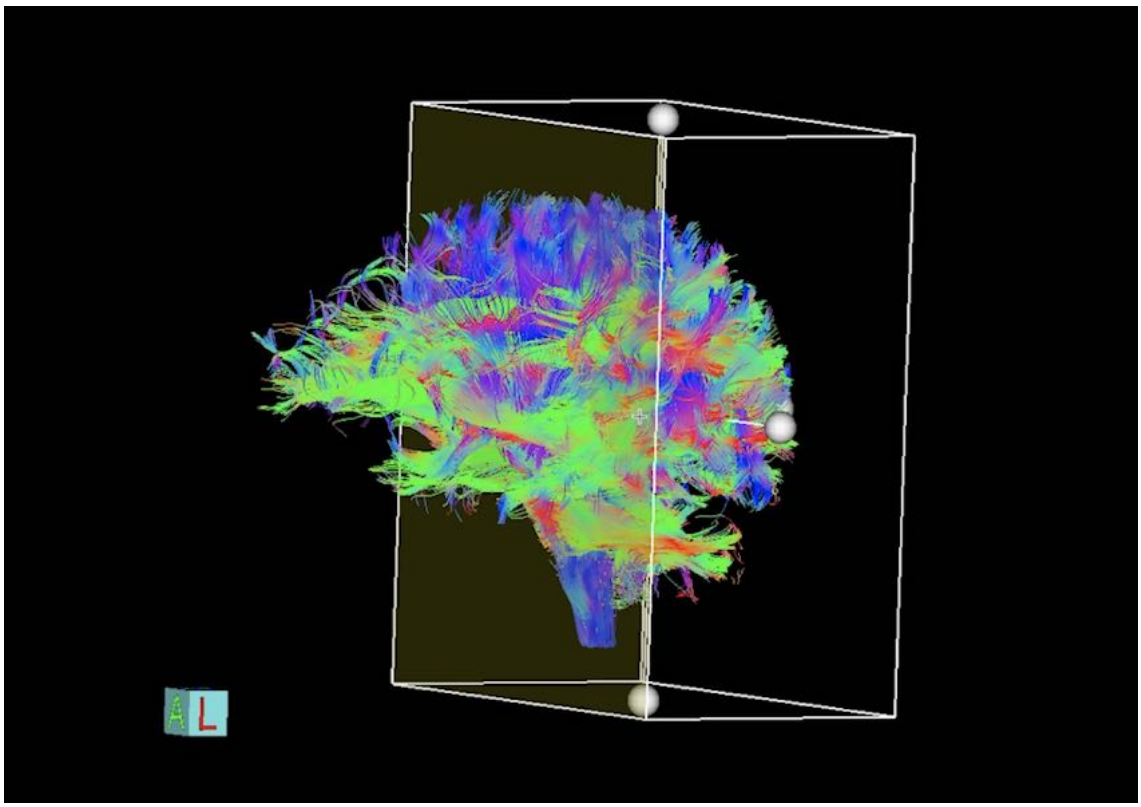

fig.folio41: **Neural connection image from scan at Erasmus MC**

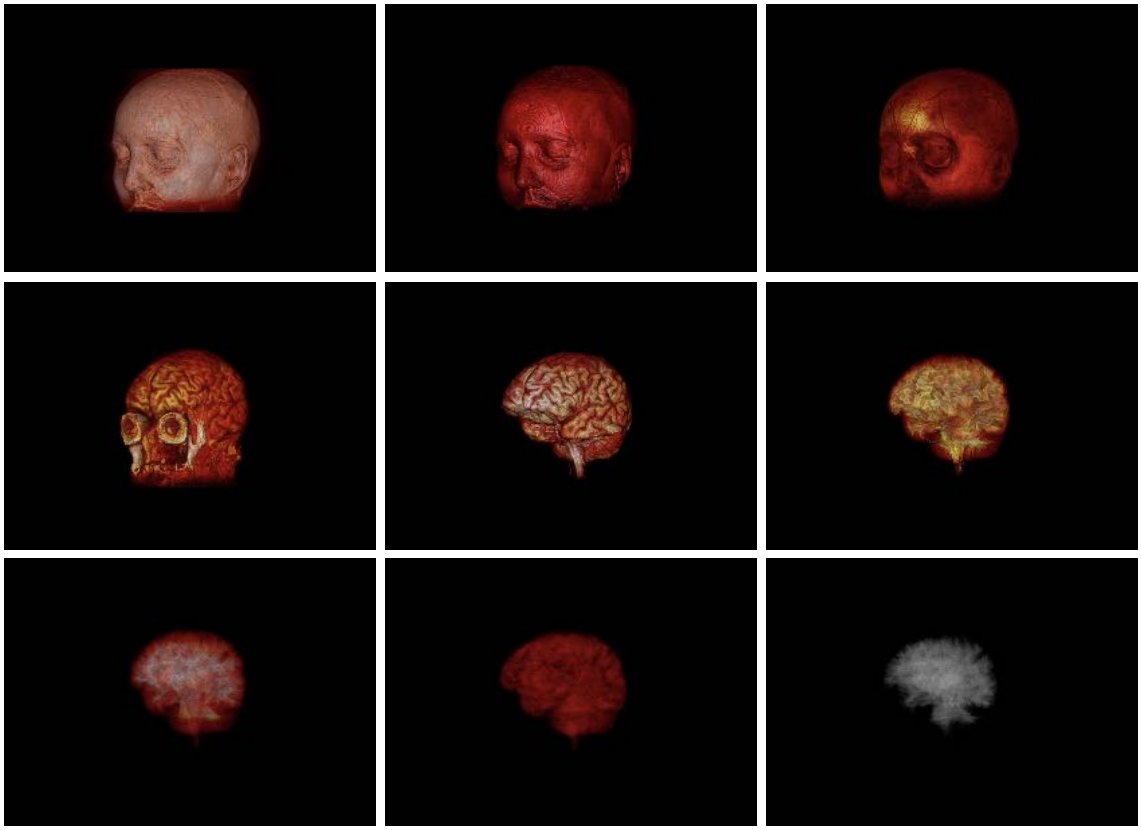

fig.folio42: **Storyboard for head dissection film made from 3D scans of DTI made at Erasmus M**

‘IF YOU PRICK US, DO WE NOT BLEED?’

This sculpture is an empathy tool to train human relationships with humanoid robots and artificial intelligence.

This responding robotic head reacts to negative stimuli and manipulates and measures the viewer’s emotional arousal. The robot is programmed to respond in different levels of intensity based on the person’s action towards it. If someone raises their voice to the robot it will frown, if they shout it will cry, and if they scream it will suffer a nose haemorrhage. The work takes reference from the famous Shakespeare monologue from the Merchant of Venice in which the protagonist proclaims that all people no matter the race or religion should be considered equal as they share the same bodily materials and processes, they are human. In the race to generate robotic likeness indistinguishable from humans this project reminds us that if a robot shares human materials and processes should they have the same rights and legal status as human beings?

This work encourages a consideration of the implications of implementing and testing new technologies when those vulnerable are often unconsidered. Can our treatment of those used for testing in the past be justified by the knowledge gained?
And, although speculatively, in reference to the sci-fi visions of robots uprising perhaps Skylock's warnings are apt *"If you prick us do we not bleed? If you tickle us do we not laugh? If you poison us do we not die? And if you wrong us shall we not revenge? If we are like you in the rest, we will resemble you in that."*

Exhibitions:

Research Through Design conference

fig.folio43: **The robotic head suffering a nose haemorrhage**

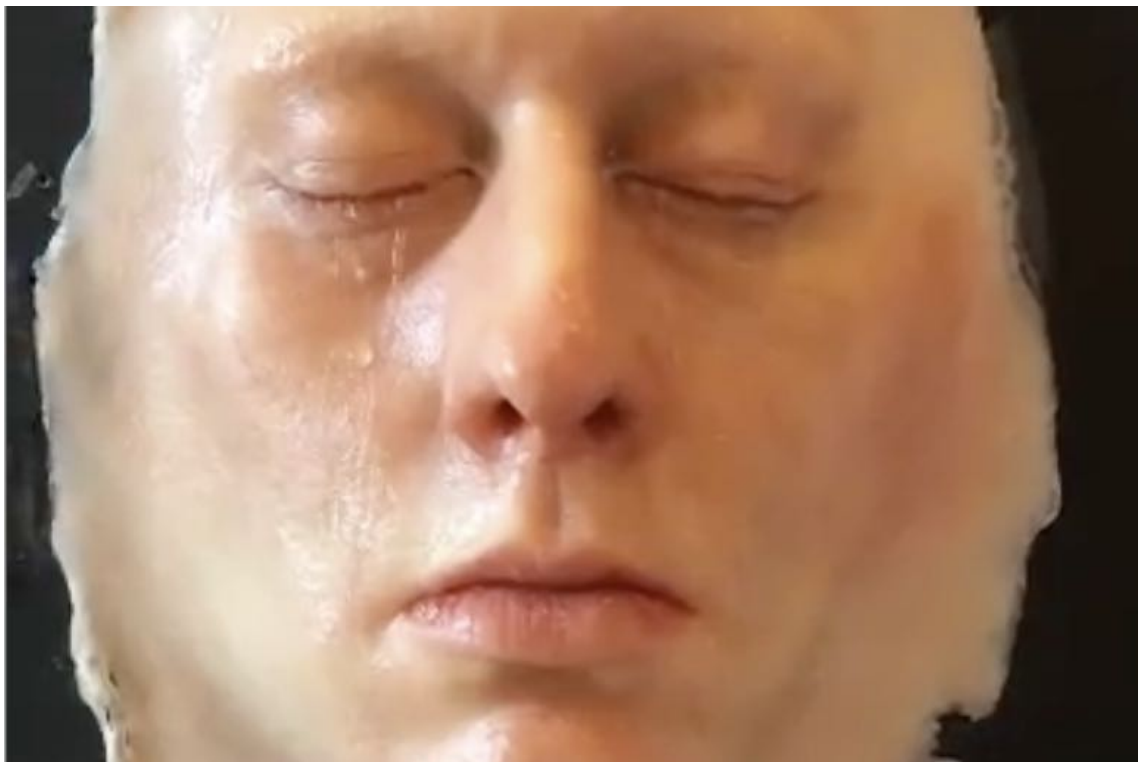

fig.folio44: **The robotic head crying**

fig.folio45: **Robot in location at Research Through Design Conference**

SPIRIT

Funded by: IDEO London

Collaborators: IDEO

A project imagining modifications that might enhance social interaction for the elderly.

This project was made for 'The New Old' exhibition for Design Museum London, the modifications take the form of daily physical reminders that they should engage in social activity. The work looks at the increasingly intrusive ways we allow technology to permeate our lives and body. And encourages us to consider the perceived role of the elderly in society and the pressures they face in being active members to the point of extreme.

SPIRIT is a fictional device which manages social interaction through artificial intelligence, infiltrating all actions using new techniques and technologies. SPIRIT is designed as a technology that will help or benefit interaction yet the user allows their body to become the subject of decisions made by the machine. In effect replacing a part of the person's spirit.

Digital somatic interface:

A nanobot swarm in user's intestinal tract, delivering unobtrusive notification to user of valuable social contact

in proximity.

Neuro-augmentation Gateway:

Spirit's central control unit for processing biosensor, nanobot, online and environmental data, housed in the earlobe

Organic social interaction display:

A micro bio-display showing the user's physical human contact, over the past month

The exhibition also included film work, illustration and interactive elements which can be viewed on the idea website below

Exhibitions:

Old New, Design Museum London

fig.folio46: **Neuro-Augmentation Gateway at Design Museum, London location**

fig.folio47: **Organic Social Interaction display at Design Museum, London location**

fig.folio48: **Digital Somatic Interface at Design Museum, London location**

fig.folio49: **Spirit set up at Design Museum, London location**

PARASITIC PROSTHESIS

This project envisions symbiotic life with modified parasites. The idea of a central figure of comparison within scientific research has resulted in the generation of a human ‘average’ through the creation of norms and standards. Forming an accepted societal basis, which is difficult to adhere to. The design of prosthetics aims to satisfy these norms visually and mechanistically for the benefit of onlookers, yet not chemically or hormonally for the user.

Producing a living prosthesis that is modified to transfer the precursor to hormone production within its saliva, may offer functionality beyond the aesthetic, through symbiosis, for example, additional testosterone production post orchidectomy. Although functionally this furthers the connection to societal norm the methods used to achieve ‘average’ are perhaps not perceived this way.

Exhibitions:

Last Breath, Clearlake hotel

Technophilia: Design and the corrupt body

fig.folio50: **Parasitic Prosthesis installation at Clearlake Hotel location**

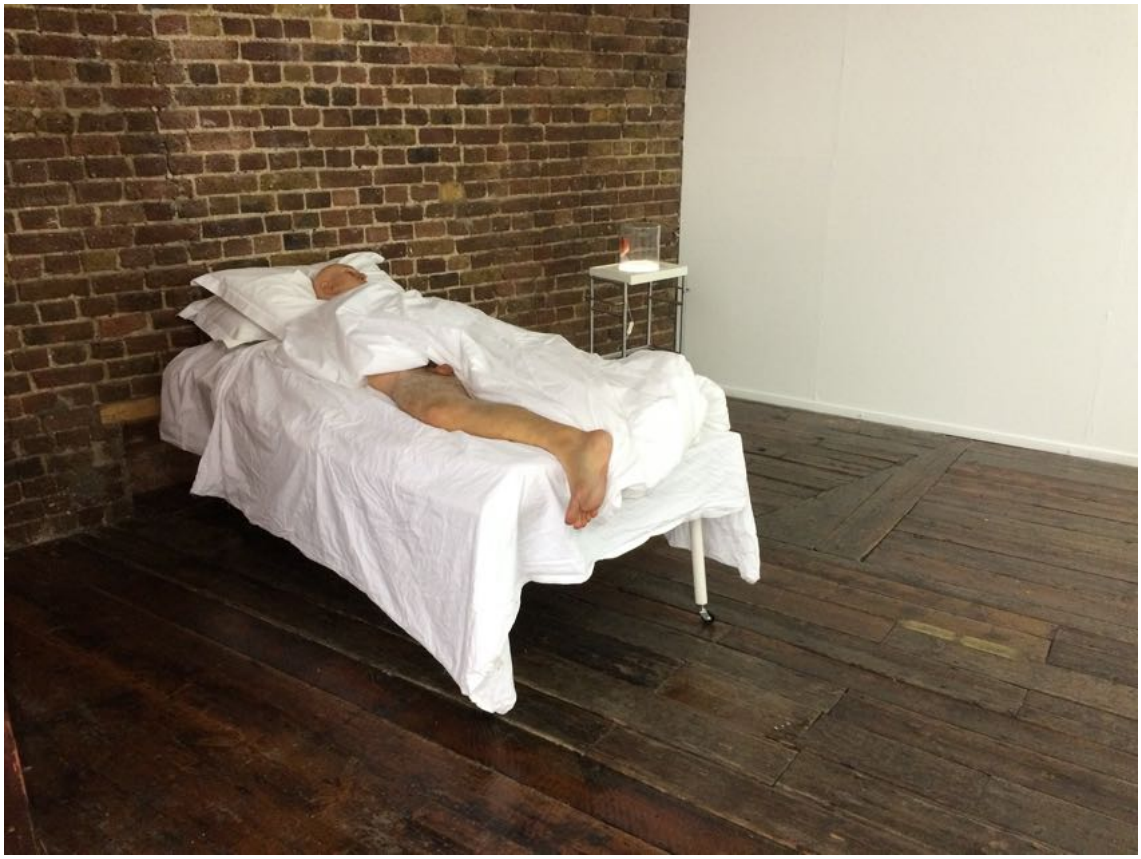

fig.folio51: **Parasitic Prosthesis installation at Menier Gallery location**

fig.folio52: **Work in progress of the 'living prosthesis'**

fig.folio53: **Work in progress of the figure**

ALTER-TERRESTRIAL

Funded by: Non-Agency, Sweden

Collaborators: Nicholas Tamás

When does terrestrial life become alien?

In the endeavour to reach increasingly beyond earthly limits, various living creatures have been exposed to the harsh environments of space travel. As missions lengthen so does knowledge regarding impacts of long-term space expeditions on the character and composition of those beings jettisoned away from their terrestrial home.

Currently when biological beings return from space they attempt to readapt and reintegrate to the conditions of earth, often with long-term physiological problems. But longer term missions may result in changes which could alter the forms of these beings irrevocably. Therefore the environment of space travel may re-shape and re-design life originating from earth as we know it.

These model specimens reveal how beings, at one time thought to be terrestrial, change to the point that reintegration on earth would no longer be possible. For these beings the off planet environment has become the norm and their morphological changes make them alien from earth life.

These biological beings are in a sort of adaptive purgatory, not yet fully comfortable in the new environment of space but also no longer finding comfort on their home planet, they are ‘alter-terrestrials’, not quite terrestrial, being of or from earth, and not quite extra-terrestrial, being of or from space, the alter-terrestrial is a being that exists between. These models show examples of the altered morphological forms that might be the stepping stones to life elsewhere.

Exhibitions:

Age of Entanglements, Volvo design space, Malmö Sweden

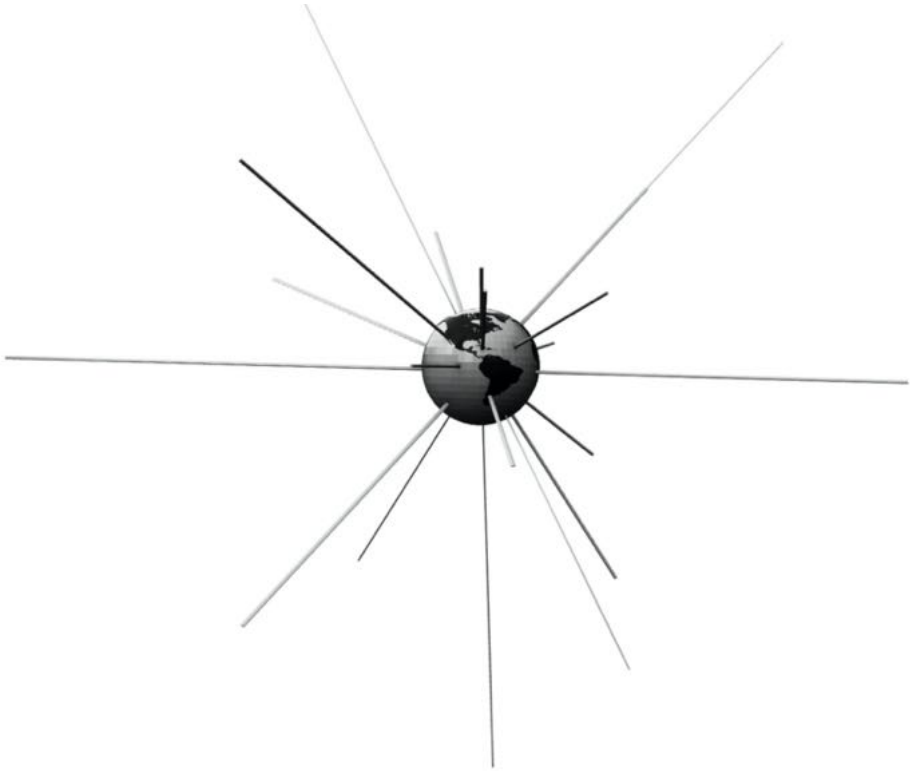

fig.folio54: **Initial concept development: time spent away from Earth**

fig.folio55: **initial concept development: physiological changes in a Chicken**

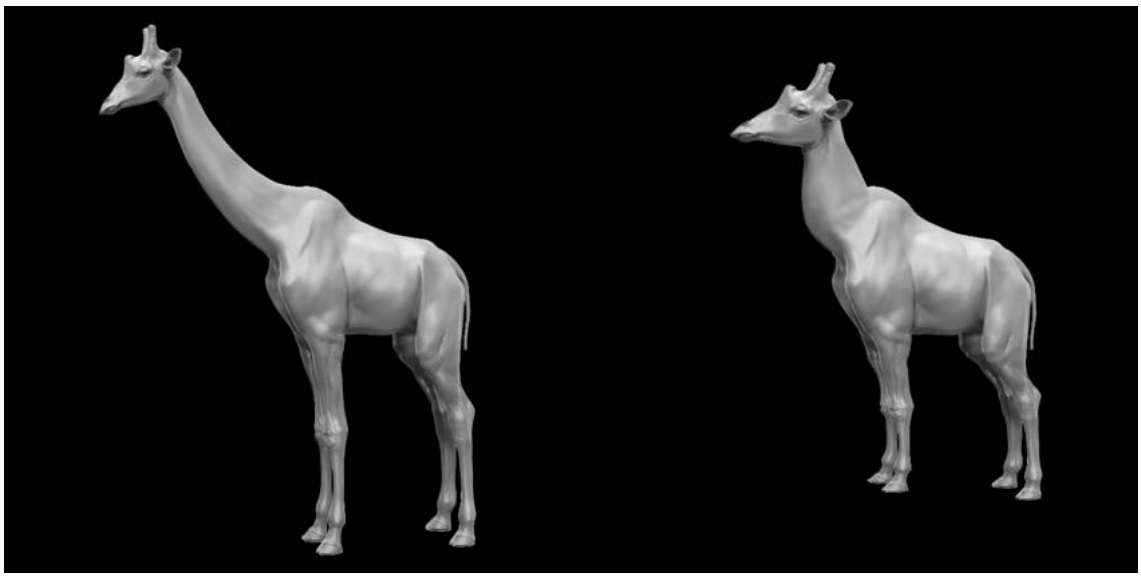

fig.folio56: **initial concept development: physiological changes in a Giraffe**

fig.folio57: **Alter-Terrestrial: Cabbage and Alter-Terrestrial: Fungus at Volvo Studio location**

fig.folio58: **Alter-Terrestrial: Pig at Volvo Studio location**

fig.folio59: **Alter-Terrestrial at Volvo studio location**

RE/ME

Funded by: DART and Swissnex

Collaborators: Sean Clarke, Diego Maranan, Frank Loesche

RE/ME is a tool that uses vibration and sound to increase body awareness. Body awareness can positively influence a range of different mental and physical issues. One way to increase body awareness is to apply vibration on the skin. RE/ME applies targeted and carefully composed vibration on the body to enhance awareness of those parts. RE/ME is a mediator that encourages reconnection with your body.

Exhibitions:

Swissnex, San Francisco

fig.folio60: **‘RE/ME’ experience (promotional)**

fig.folio61: **User experiencing ‘RE/ME’ at Swissnex location**